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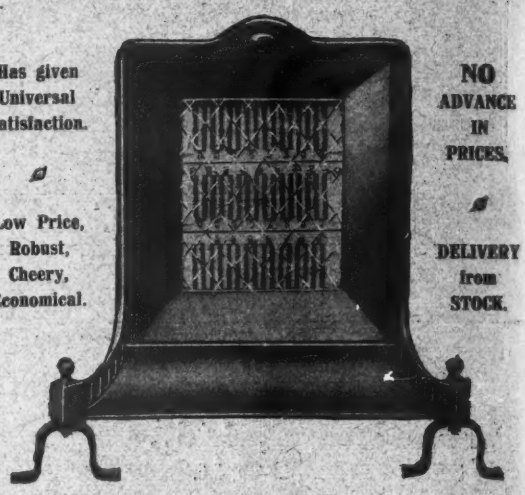

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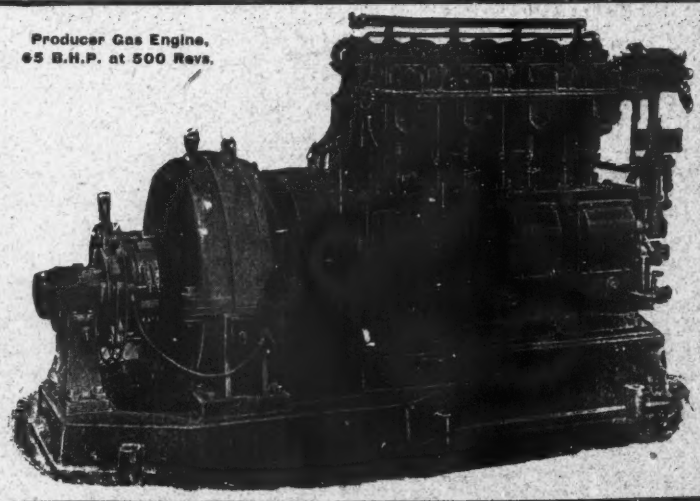

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ENLIGHTEN THE BUYER ABROAD.

FROM our reading of the criticisms and warnings that are being published in some of the distant markets, we judge that it is high time for the British electrical manufacturer to break silence and remove an unfortunate impression that has obtained currency. We refer to the impression of anxious would-be purchasers that we in this country are indifferent regarding the future effect upon our trade of the hold that neutral nations are gaining while we are waging war for all we are worth on the battlefields of Europe. We must make due allowance for the fact that some of the markets that we have in mind are far removed from the great war zone; whatever traders there may read regarding the state of things cannot convey to their minds exactly the same impression as that made upon the minds of those who are right "in the thick of things" at home. We have by the pressure of our blockade cut off their supplies of enemy manufactures; we are only able to handle a small part of the export orders that are available, though that small part, as our foreign trade statistics show, amounts to a very respectable total value every month; our continued preoccupation with munitions manufacturing as well as the tonnage position and the necessity for Governmental regulation in respect of essential materials, prevents us from doing all that we desire; and these would-be buyers in distant lands are apt, as they contemplate their empty stores or depleted stocks, to charge us with indifference to their needs. They are imbued with a burning zeal for British trade progress, are eager to utilise or sell British products, and only under the sheerest necessity can they compel themselves to avail themselves of supplies that other nations are able to offer. They have, in many cases, tried to persuade clients—public and otherwise—to defer their orders until after the war; but sometimes that cannot be done. We believe that the warnings that they offer regarding the after-the-war effects of the prevailing favourable opportunity of neutrals are sincerely offered, and are evidence of a true patriotism; any irritation or feelings of annoyance, or any suspicions that they entertain regarding apparent indifference, will be better understood if we ungrudgingly recognise that fact. We are waging a war for the freedom of the whole world from the powers of darkness, and our friends know that we are anxious to maintain our exports to assist our operations on the financial side, but they are prevented from "doing their bit" in that important connection, and incidentally, perhaps primarily, they are obliged to offer, or see somebody else offer, neutral substitutes to clients many of whom they have previously supplied with British goods. This aspect of the need for maintaining our export trade is an important one, but our friends abroad must not think that it has been lost sight of, either by the Government or by the industry. The difficulty, when the demand is so heavy upon us for all kinds of material and activity, is to reasonably reconcile all these different requirements, assuring the attainment of efficient national organisation without in the process causing too serious a disorganisation of export industry. What seems to be needed at the present time is some action, whether united or individual is for the trade to say, to impress the foreign markets with the fact that we are not leaving things to take care of themselves until after the war; to assure them that we shall have almost infinite export trade capacity when we can devote our greatly increased energies to it; and that we are, or shall be, able to supply from British factories many lines that before the war they could not obtain here. We do not know how far Teutonic competition will count in foreign electrical trade in days to come, but the neutral nations' position may be strong, though there will be an abundant demand in and from all countries, which we confidently believe will occupy

all the manufacturing nations with electrical and engineering work for some years. But while we believe, taking into account everything as far as we can see it, that our advisers abroad are inclined to take a somewhat exaggerated and pessimistic view of the outlook, we think that it would be as well if organised electrical manufacturers were to weigh up the situation, and see whether they cannot do something impressive, and that immediately, to dispel wrong impressions as to their own goodwill, good intentions, and prospective ability.

If in the early days of the war there was a feeling in some quarters that economic conditions would decide the state of things after the war, and that, therefore, no organised effort was necessary, we can certainly say that no such feeling exists in the electrical trade to-day. The weakness now is rather that we are tempted to conceal what we are doing, what preparations we are making, and to hide our light under a bushel. Surely there is room for an impressive and effective publicity, without playing into the hands of either enemy or neutral traders. We have good reason for knowing that the reader abroad is often a far closer student of his trade journal than are some readers at home. In our own case our pages have dealt practically continuously with such subjects for nearly two and a-half years, and the schemes for the organisation of the engineering and electrical industries have been frequently dealt with. It would appear, however, that while this organisation movement at home is proceeding, there is a need for some speeding-up in the local British organisation efforts suited to each particular market. But it may be that the light is hidden from even us at home.

The Ministry of Munitions and Controlled Firms.

The recent substantial concessions granted by the Ministry of Munitions to the application made some time ago by the Trade Union officials for considerable advances in wages rates, ranking of women workers at the same rates as would be paid to men for doing the same class of work, and other important points, have resulted in no small amount of criticism from employers in the electrical and allied industries.

To arrive at a fair and impartial judgment of a matter of such far-reaching importance, a great variety of interests and considerations must be carefully reviewed. The heavy increase in the cost of living obviously necessitated an increase in the income of the working man. Whether the increased wages have more than covered, or only partly covered, the increased cost of living, we can only judge from official figures, which, in cases of this nature, do not always present a correct reflex of the situation. In most cases, however, it may be fairly said that the increase in wages has not yet exceeded the increased cost of living.

It is not to be supposed, however, that the one consideration should be expected to regulate the other, since it would be obviously quite impossible to raise or lower the rate of wages with every rise or fall in the cost of living. The demands of the workers during the war period for increased wages to meet the increased cost of living have, we think, with some exceptions, been generously met by employers, in consideration of the fact that, for the most part, the employers have obtained increased prices for their goods.

The point of just grievance among employers is not that the workers' demands for more money have been unreasonable, but that too often the increased wages paid have not resulted in a corresponding increase in output by the workers. Indeed, it has been asserted frequently that the output per man in some controlled firms has actually been less since the increases in wages rates were granted.

Recently several important firms controlled by the Ministry of Munitions received instructions from Whitehall to increase further the rates of pay, include the war bonus, which had been paid as a purely separate item, in the rate of pay, and pay all women considered to be doing a man's job a man's rate of pay, regardless of whether or not the job had ever at any time been done by a man, or whether, as was more frequently the case than not, it had always been done by a woman or a girl. The result of the latter provision is that the employer has been compelled to pay at one stroke increases of 50 to 60 per cent. for the same class of work as was done previous to the control of the Ministry, or equivalent to about 75 per cent. on pre-war rates.

It has also to be borne in mind that whereas the Ministry of Munitions was, we believe, reluctantly persuaded by the Trade Union officials into granting these concessions, no satisfactory safeguards against bad time-keeping, ca' canny, &c., appear to have been secured by the Ministry. To those employers who have felt the bad effect of the disrespect, almost contempt, of some workers for the authority of the Ministry, this further omission to grasp the opportunity to tighten up the loose parts which are so greatly impeding the full effectiveness of the vast war machine is far from reassuring.

The imposition of fines for bad time-keeping, &c., appears to have resulted only in benefiting the funds of the Munitions Tribunals; indeed, we are of the opinion that the questionable system of wholesale fining in munition shops, &c., which has been going on for some time past, is far too prevalent throughout the country.

The result of this somewhat accommodating attitude of the Ministry of Munitions to the Trade Unions will be felt more forcibly after the war, when the Ministry releases its control of the establishments. Then the employers will be faced with the serious question of wages adjustment. In consideration, therefore, of the recent important changes effected by the Ministry of Munitions for its own immediate needs, it becomes a matter of vital importance to employers and all concerned to be assured that the Ministry of Munitions is fully prepared to accept joint responsibility with the employers for the readjustment after the war of the changes made by the Ministry during the period of its control.

To leave the employers and workmen to settle this question among themselves after the war would be tantamount to precipitating the most grave industrial conflicts, and, moreover, it would be equivalent to a serious breach of trust on the part of the Ministry.

Central-Station Service.

No one can call in question the patriotism of the men who, whether as managers or subordinates, are responsible for the maintenance of public electricity supply in this country; many of them have made the great sacrifice which marks the very acme of human devotion, many others are fighting in the trenches—good luck to them!—and their colleagues who are prevented by age or public service from joining them, are working long hours and doing double duty to keep the mains alive. But there are limits even to their elastic capabilities, and now that the "comb" is being applied more vigorously, but not always more wisely, the strain in some cases has approached the breaking-point. The supply of electricity is a highly technical undertaking, which cannot possibly be carried on without an adequate number of fully trained men; for such men substitutes cannot be found, and in their absence there is no alternative but to shut down the plant.

The case of Diesel engine stations is particularly hard; the Diesel engine is of comparatively recent introduction into electricity supply, and the number of men who understand the niceties of its working is extremely limited—moreover, almost all of them are young, and, therefore, greatly to be desired of the military authorities. Already we have heard of one Diesel station losing its chief engineer, and we know of another which is faced with the prospect of an inevitable shut-down if one more of its staff be taken. Surely such men come within the clause of the circular issued to the Tribunals last week, which states that "the exceptions to the 26 years of age instruction include men urgently required for work of essential national importance for whom the demand is greater than the supply"—for the work that these men are doing actually includes the supply of electricity for national purposes of the highest importance, and *there is no supply of such men to draw upon at all.*

It is not for us, however, to direct the policy of the Government; we only wish to emphasise this simple and incontrovertible fact—that *if the Diesel experts are removed from Diesel-engine-driven stations, those stations must inevitably shut down.*

SOME CHIEFS—VERB. SAP.

By "TRAMP ROYAL."

It was the way I was addressed that made me take the job. Not a well-paid offer and not attractive work. The moment the chief entered at the interview I was on his side; and I stuck there, going seven years through dismal days amidst figures, and sunny days amidst manholes and lattice masts. There was candour and justice written on the stern face, and the greyish eyes were humanely sympathetic. There was no suggestion of the usual chilling remark warning one that "it will depend upon your own efforts whether we keep you," before one has had a chance to play a single card. I always think that remark could be saved for the day of delinquency. Year in and year out there were many discouragements when the "firm" did foolish things, but the anchor at the head always held fast.

Often in trying times an invisible thread will hold us to the bench, board, or desk, and yet it is but a slight trait of the chief that will, under perhaps more favourable conditions, snap the cord of enthusiasm.

There were other chiefs before and since the erect, gray-haired gentleman just introduced. My first, after shaking the filings of the loco. shop off my feet, was a smart, keen business man, always on the alert, and from whom I received many useful hints of a diplomatic nature. I might have been with him to this day, lulled by the whirr—r of Belliss' and Willans' creations, but for the fact that he went to the rescue of a seaside corporation. The replacement of the "old crocks" by modern machinery made breakdowns an almost unknown quantity, so my grip was packed, and I crossed to the land of sauerkraut and helmets, to study other characters and, incidentally, three-phase mysteries. I had a succession of three chiefs here before the *Moltke* took me to New York; but I won't use up scarce paper in describing their excitable ways and close adherence to rules and regulations. My ears still tingle with "Ach, mein Gott! dass dürfen Sie nicht, weil es nicht regelmässig ist"—and there you are! as Dan Leno so often said.

A big American trust or corporation offers little opportunity for one "to get a line" on his boss. The man who "makes use of you" is but the shadow of a chief. It is he who guides your erring footsteps through the labyrinth of card indexes, files, code lists, and vault records. Hang on to him, and he soon "puts you wise to the right dope." He initiates you into those effort-saving devices that husband the gray matter and prevent the headache of a London office. You learn that strenuousness is not efficiency, and that England is the home of the "hustler," regardless of who coined the word.

Two visits to the Pacific Slope, with a 13 years' interval between, give a mental picture of two chiefs, framed in palms and pepper trees, eucalyptus and mimosa, sunshine and earthquake. Snapshot No. 1 is of Southern California, living with the chief in his ingenious bungalow, on the bluff, overlooking the Pacific Ocean with its gorgeous sunsets. He was a Canadian branded with the Yankee spirit, for he had a keen appreciation of quick methods, jigs, templates, and other "stunts." We had happy evenings together, and he did not wear out his welcome by visiting the work continually. In fact, through that winter I was left for weeks on end to revel in a continuous blaze of sunshine (O ye English winters and defective cables!) what time my little gang wrestled with tees, channels, and trifurcating boxes, or balanced tons of machinery on primitive jacks and "horses," some miles way back from civilisation. We improved the shining hours until the evening train was flagged and bore us home.

The other American, with his gaunt figure, long hair, and keen hatchet face, was of quite another type, and ruled with a shrill voice in the city of the great 1915 Exposition. "He was a wise guy, and some boss, believe me." He permeated the routine of the office with the methods of the old school. One slid along in cycles of *laissez faire*, and being pulled up with a jerk, and team work was out of the question.

Then the war came, and one's own country called.

Two other portraits must be placed in the gallery. We meet many engineers of the type which seems to have been weaned with extract of machinery. The cold, phlegmatic temperament, choking-coil demeanour, and studious appearance are often supplemented by a woeful lack of the understanding of human nature and applied psychology. Just such a man was the chief who managed with annoying persistency to mail me a letter on Fridays, detailing work for the week-end. How his staff blessed him, and how they "played him up" over and over again, need no labouring here. At the close of the contract I returned to the London office, and eventually my enthusiasm oozed out and left an aching void, so for the peace of my conscience I quit.

The tramway manager with the heavy moustache and firm, square jaw was a good leader of men, and knew how to work the gang up to "He's a jolly good fellow"; but he had the fear of the Councillors in his soul, and a habit of interfering at breakdowns while the music was played to $x = \text{L}\, a/(a + b)$. His sense of humour was the balm that soothed the chafed and jaded spirit.

Chiefs embody every phase and type of human nature, and therefore these few reminiscences make but a fringe.

THE BONDING AND ANCHORING OF ELECTRIC CABLES.

By S. G.

The bonding and anchoring of electric cables did not, until a few years ago, receive much consideration; but since then the matter has been engaging the special attention of cable engineers, particularly mining engineers.

To the mind of the engineer who deals with "larger things," such as engines, generators, &c., this bonding and anchoring of cables would appear a very trifling matter; but experience on cable work has proved that it is a subject which requires very careful attention, especially when the cost of the cable is taken into consideration.

Many are the designs put forward on paper, but few are adopted. It is not the writer's intention in this article to boom any particular design as being the most practicable, neither is it intended to state which manufacturer brings out the best design. The subject is one on which very little has, up to the present, been published, and the illustrations, with their accompanying comments, are for the benefit of designers, manufacturers, and users alike. The figures, of course, do not represent every possible design, but only a number of selected examples.

It would be well to point out that when getting out designs of this particular class of gear, the designer should always bear in mind that, for "armour grips" especially, *strength* is one of the main requirements to provide for, and, whatever method is adopted, he should make certain that the armouring will be "gripped" properly and a solid job made of it—not only an electrical job, but a good mechanical one, in the very essence of the word—otherwise serious trouble will be the outcome.

With regard to mining work, one often hears the yarn about the collier venting his spite on electrical apparatus and driving his pick into anything electrical that he comes across. This yarn has almost had its day, and is very often "pitched" by persons who like to give one to understand that they are fully acquainted with "underground" conditions of working, yet have never even been in close proximity to a colliery. The writer has known of several instances where this tale has been pushed down the throats of draughtsmen, and would suggest that the actual designers should have opportunities, which are at present mostly denied to them, of going to the job and ascertaining what is required.

The writer's experience in mining work is that the conditions are not quite so black as they are painted; at the same time, he would emphasise the fact that everything

used in the workings must be designed for strength, and only the best materials must be used.

Fig. 1.—Illustrates, perhaps, the oldest method, and one which is used a great deal at present, of bonding the lead sheathing of the cable to the cast-iron box. The lead or copper tape is secured to the box between two brass washers by means of a brass screw. The tape is soldered to the lead sheathing of the cable. This method of bonding is simple and cheap, but care must be taken to solder it properly.

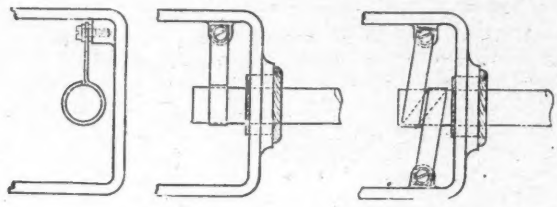


Fig. 1. Fig. 2.

Fig. 2.—Illustrates an improvement on fig. 1, the bonding tape being wrapped around the cable and secured at both sides of the box.

Fig. 3.—Illustrates how the lead sheathing of the cable is bonded by means of a cast lead or alloy bush fixed between

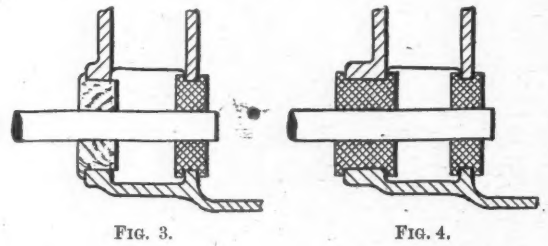


Fig. 3. Fig. 4.

the two halves of the box. This method of bonding is also cheap, and is effective provided the lead bush fits the cable properly and the two halves grip the cable tightly when the parts of the box are bolted together.

Fig. 4.—Illustrates an improvement on fig. 3. A cast lead or alloy bush is provided for both the inner and outer wall of the box.

Fig. 5.—Illustrates a very cheap method of bonding. The holes in the glands of the box are a little larger than the lead of the cable, and are made up with lead tape, as in fig. 6.

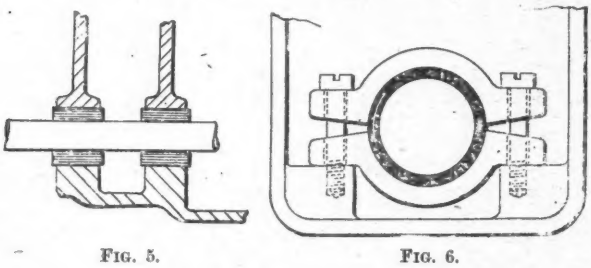


Fig. 5. Fig. 6.

Fig. 6.—Illustrates how the lead sheathing of the cable is bonded by means of a pair of malleable or gun-metal castings. The hole in these "grips" or "bonds" is slightly larger in diameter than the lead of the cable. Lead tape about 1/16 in. thick is wrapped around the cable to such a diameter that when the bonds are screwed down to the box the cable is gripped perfectly tightly.

Fig. 7.—Illustrates a type of gland which is usually used

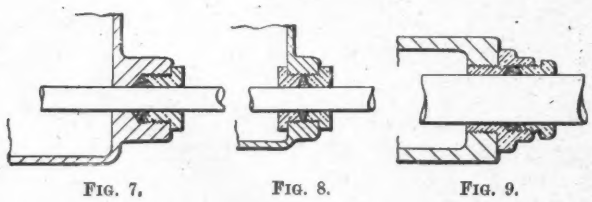


Fig. 7. Fig. 8. Fig. 9.

for rubber cables. This gland can be used for lead-sheathed cables if desired, the packing material being lead wool.

Fig. 8.—Illustrates a similar gland to fig. 7, but two glands are used instead of one.

Fig. 9.—Illustrates a similar gland to figs. 7 and 8, an adapter being used.

Fig. 10.—Illustrates how the lead of the cable is plumbed on to a brass wiping gland, the gland in question being secured to the box by means of set-screws.

Fig. 11.—Illustrates a similar gland to fig. 10, with the exception that it is screwed into the box in order to make it watertight.

Fig. 12.—Illustrates a similar gland to fig. 11, but suitable for either steel tape or wire armouring, the bulb on the

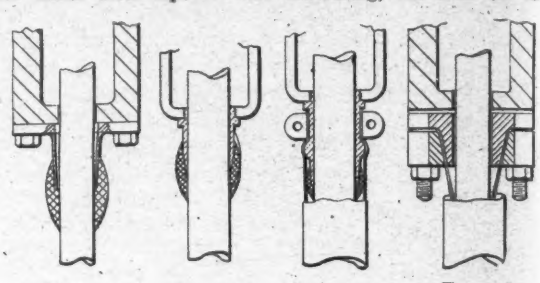


Fig. 10. Fig. 11. Fig. 12. Fig. 13.

gland being an extra precaution for preventing the armouring from being pulled out of position.

Fig. 13.—Illustrates a wire armour grip made of either cast-iron or malleable iron. The wires are gripped between the male and female cones. This method is a very good one provided the cones fit the armour wires properly.

Fig. 14.—Illustrates a similar gland to fig. 13, but the end

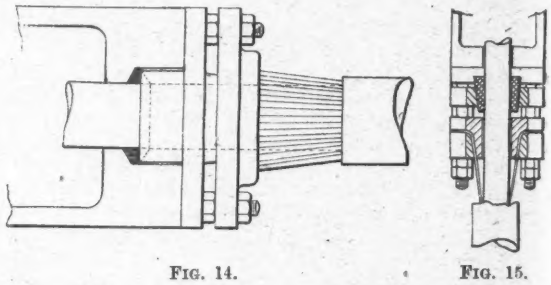


Fig. 14. Fig. 15.

of the gland which fits into the box is arranged for a packed joint, spun yarn or other suitable material being used for bitumen cables and lead wool for lead-covered cables. This type of grip is often used in mining work.

Fig. 15.—Illustrates an improvement on fig. 13. The lead sheathing is bonded by means of a lead cone bond, and the armouring is gripped between the male and female cones. If desired, the lead cone grip could be cast solid with the male wire armour grip.

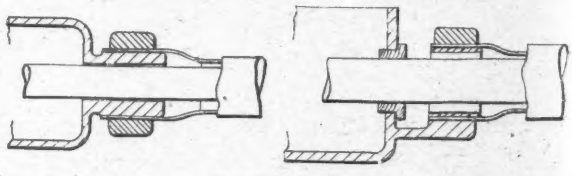


Fig. 16. Fig. 17.

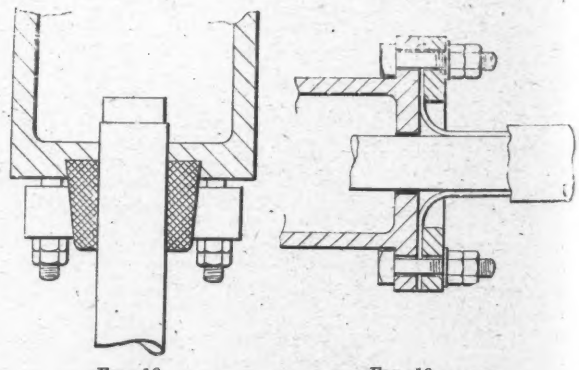


Fig. 18. Fig. 19.

Fig. 16.—Illustrates how the armouring is gripped on to a trumpet cast on the end of the box by means of a pair of cast-iron or malleable iron clamps. With this arrangement there is a tendency for the armouring to pull out of place.

Fig. 17.—Illustrates how the armouring is gripped on to a steel ferrule or tube by means of clamps, as in fig. 16.

FIG. 18.—Illustrates how the lead sheathing is bonded to the box by means of a lead cone gripped with a strong cast-iron grip. This is a very effective bond.

FIG. 19.—Illustrates how the armour wires are gripped to the box by means of a cast-iron ring. With this arrangement it is not necessary to remove the outer serving of the cable very far.

FIG. 20.—Illustrates how the end of the cable can be gripped in the case of a cable which has to be suspended at the pit

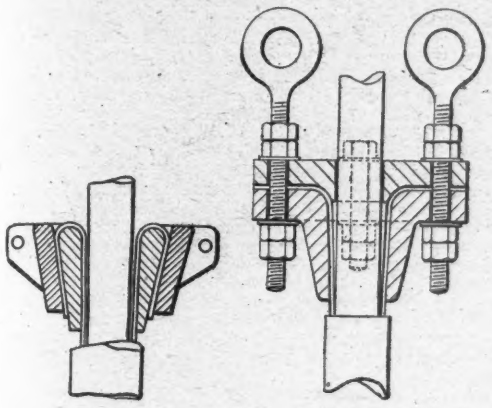


FIG. 20. FIG. 21.

head. It will be observed in this design that the cable is suspended by its own armour wires, the wires being bent over the loose cone piece.

FIG. 21.—Illustrates an improvement on fig. 20. The eye-bolts can be fairly long to allow for tightening up.

FUEL ECONOMY.

IN the *Sheffield Daily Telegraph* of November 15th the subject of electric power supply to meet the city's enormously increasing demand was discussed, with special reference to the question whether the generating station should be situated in Sheffield or in the neighbourhood of the collieries.

Prof. W. G. Fearnsides, of the University of Sheffield, who is engaged on a study of the coal measures of the district, has devoted special attention to this problem, and has suggested two schemes for a central station.

At a meeting of the Sheffield Society of Engineers and Metallurgists, last April, he distributed copies of a map (which we reproduce), showing the location of the collieries, marking especially those possessing by-product coke ovens of a modern type, and suggesting a site between Wombwell and Wath as a very suitable one for a generating station. He now goes further than this, and suggests, for the future, the erection of a great generating station near Doncaster, which would make its electricity from the second-grade portion of the Barnsley coal which is now left unworked in the pits.

In an interview with a representative of the newspaper, the Professor went fully into the matter. "Sheffield," he said, "is the capital of the main fuel-producing area of the North Midlands. It is not in the centre of that area, but on the western edge. The direction in which the coal field is being depleted is from west to east. The zone of maximum production has now got eastwards, about as far as Mexborough, and it is progressing further in that direction year by year.

"To transport fuel by truck, in my opinion, costs more than to carry by cable the electricity which that fuel can be made to produce. The half-crown which is required to bring each ton of coal up from the centre—say, Mexborough—into Sheffield, were better devoted to paying interest on the capital required to build the trunk cable line.

"There are at present two great unutilised sources of fuel which ought to be converted into power. The source with which I dealt in April, the distribution of which is illustrated on the map, is the surplus gas produced by coke ovens. The coke-oven industry is especially active in the district where the Parkgate seam is worked, and there are half a score coke-oven plants, each representing a group of collieries, situated within a five-mile radius of the 'starred' site between Wombwell and Wath.

"Wherever by-product coke ovens are worked, there is an evolution of gas averaging 12,000 cb. ft. per ton of coal carbonised. That gas is equal in calorific value to the best Sheffield town gas. In ovens of the regenerative type, half of the gas is required to carbonise another ton of coal, and half is surplus.

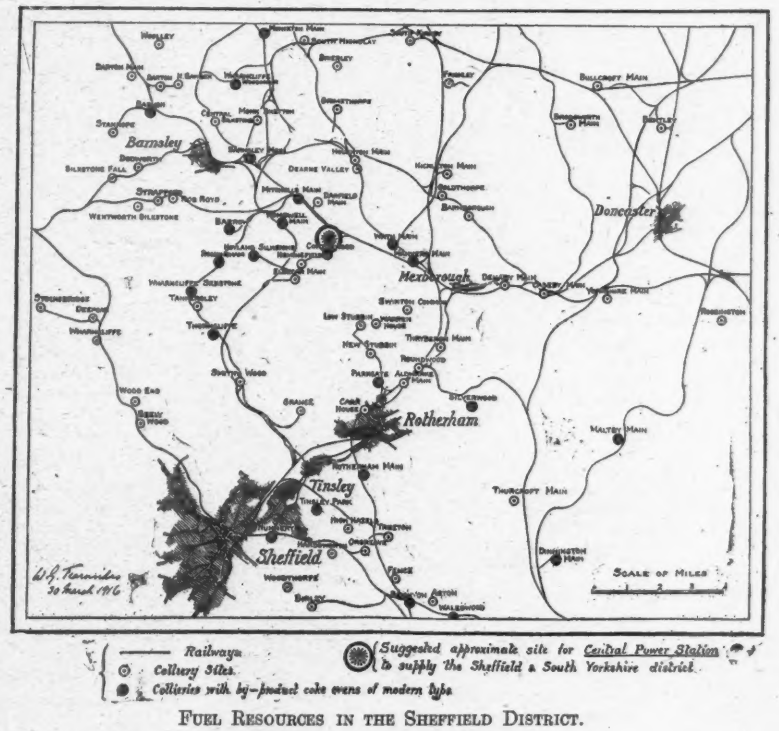
"My suggestion was that this surplus gas should be conveyed in pipes from the ovens to the central power station, where electric power could be produced from it. I estimate that there are more than 20,000 KW. immediately available from that source. I quite recognise, however, that that is not big enough for Sheffield. If linked up with the Yorkshire Power Co. station at Barugh, near Barnsley, the two, together with the present Sheffield supply, might meet immediate needs. But the growth of the use of electricity is enormous. I anticipate that the demand in Sheffield may rise to a quarter of million KW. within the next decade.

"In order further to meet this demand, I suggest the use of the inferior portions of the Barnsley seam, which at its maximum rate of production is worked further to the eastward. Owing to roof requirements, liability to spontaneous combustion, low selling price, and other disabilities, this second-class coal, which overlies the 'hards,' often to a thickness of 4 ft. and more, is seldom won, and, under present conditions, broken by the accidents inseparable from deep mining, is allowed to remain and become buried in the goaf.

"A characteristic of this coal is that if it is brought up and piled in a heap at the pit-top, it always heats. If, however, it could be screened and washed, and then put straight into trucks and taken to some big central generating station, where it could be used the same day, it would give almost as great a number of units of heat per ton of coal burnt as will the best fuel that comes to Sheffield.

"There is in this district, easily accessible, enough coal of this class to generate electricity in large stations to the extent of hundreds of thousands of kilowatts. It is not worth while to mine the coal now, because it cannot be got rid of without a great deal of trouble to the selling departments of the mines. Any big quantity of it could only be raised by co-operation between the very large collieries which are working in the area nearer to Doncaster than to Sheffield. The line of maximum production now passes about north and south between Conisborough and Mexborough. The production east of that line is increasing, and will continue to increase. West of that line, production is diminishing, and cannot be increased. Therefore, a central power station to use this supply of fuel should be located not nearer to Sheffield than the line of maximum production which we have mentioned, and the current could be sent, at no great cost per unit, from that station to Sheffield.

"For the generation of electricity in large units by the only method which has yet been proved to be perfectly satisfactory on a large scale—boilers to raise steam which is used through turbo-generators—much water is required. For generating sets making hundreds of thousands of kilowatts, the quantity of water flowing over the Wicker weir in dry weather is insufficient, and it does seem necessary that, for the purpose of condensers, a site down stream, below the confluence of the Don and the Rother, should be found. The further we go down stream, the more water becomes available, and when units grow, this is a matter which will have to be carefully considered.



FUEL RESOURCES IN THE SHEFFIELD DISTRICT.

"Any really efficient scheme for utilising the Barnsley coal would involve the use of 'producers,' which make gas for firing the boilers, and this system has a great deal to recommend it from the point of view of national economy. The ammonium sulphate which is recoverable by washing raw gas with acid before it goes to the boiler is sufficient to defray the costs which the utilisation of producers will demand. Gas also is a material which can be fired in the place where it is wanted, which travels in pipes under pressure, and which needs neither a shovel to feed the fire nor a cart to take away the ashes. The time has come for the use of gas and the application of electricity to take its proper share in the economic life of our manufacturing community."

THE INTERNAL-COMBUSTION ENGINE.

By DUGALD CLERK, F.R.S.

(*Abstract of paper read before the* Royal Society of Arts.)

In the development of internal-combustion engines we have borne our full share of pioneer work. The subject is one to which I have devoted much attention for the past 40 years, which have seen a marvellous development of the gas engine, and an extension of the use of different fuels has caused the old title "gas engine" to disappear in favour of the more general term "internal-combustion motor," lately shortened to "combustion motor," which includes all engines known as gas, petrol, and oil motors.

The total power generated by internal combustion in the United Kingdom in 1907 was:—

	Horse-power.
In factories, stationary gas, oil, and petrol engines	680,177
For agriculture, stationary gas, oil, and petrol engines	98,785
For motor-cars and cycles	750,000
	1,528,962

In Germany at the same time the total power generated by internal combustion was:—

	Horse-power.
In factories, stationary gas, oil, and petrol engines	351,000
For motor-cars and cycles	180,000
	531,000

The census of production of the United States of America for 1909 shows that there were in use 1,299,021 H.P. of gas and gasoline engines for the stationary work of manufactures and mines.

Nearly 115,000 motor-cars were produced in that year; this, with the vehicles in use, required engines of a total of about 1.2 million H.P., so that the total combustion power for the United States was certainly not short of 2.5 million H.P.

Allowing for the increase of Britain and Germany from 1907 to 1909, a probable value for the total combustion power of the three nations in 1909 is five million H.P.

In 1909 France had 46,000 motor-cars in use of an average of about 13 H.P., or a total of 598,000 H.P.

The power of stationary combustion engines in France is not available, but the four countries show a total of at least 5½ millions in 1909.

This figure does not include oil and petrol engines used for marine purposes, which probably brings the total up to six millions.

In 1909, then, we find at least six million H.P. of gas, oil, and petrol engines in the world, a truly great development since 1876.

In addition to internal combustion, all these engines have another feature in common—all compress the working fluid before combustion; some compress an inflammable mixture and fire the compressed mixture, producing a mild explosion with a strictly limited possible rise of pressure; some compress air alone and then mix at the temperature of compression the inflammable gas or vapour and ignite as before; and some compress the air charge so highly that on the injection of oil fuel in a state of very fine spray the heat of compression causes the ignition of the spray as it enters the cylinder—such engines do not produce an explosion; the pressure within the cylinder never exceeds the pressure of compression or the pressure of the compressed air sometimes used to pulverise or disperse the liquid oil.

Two mechanical cycles are in general use: in one the motor piston and cylinder alternately act as pump and motor, so that four single strokes are necessary; in the other these operations are performed in two single strokes of a piston; air or the charge, however, has to be pumped and lightly compressed by a separate lighter piston or by the front of the motor piston.

This feature of compression before ignition is necessary in order to provide an economical engine expanding the gases of explosion in the most favourable manner, and at the same time producing large power for small bulk. This mode of operation was described in Wm. Barnett's Patent No. 7,615 of 1838.

M. Alph. Beau de Rochas, a brilliant Frenchman, in a remarkably clever pamphlet published in Paris in 1862, described four conditions as necessary in order to obtain the maximum economy in a compression explosion engine:—

1. The greatest possible cylinder volume with least possible cooling surface;
2. The greatest possible rapidity of expansion;
3. The greatest possible expansion; and
4. The greatest possible pressure at the commencement of the expansion.

Beau de Rochas' proposal had to wait for 14 years before it was put into successful practice by the late Dr. N. A. Otto, of Cologne, in the year 1876, when he produced the first commercially successful gas engine utilising the idea of compression before ignition, first proposed 38 years before by the English engineer Barnett, applied by the means of the cycle of operations due to Beau de Rochas.

Although in 1861, Schmidt in Germany and Million in France described compression engines with separate compressing pumps, no two-stroke engine appeared in public till 1879, when I exhibited my first compression gas engine at the Kilburn Show of the Royal Agricultural Society of England.

At the time when I was experimenting with two-stroke engines in Glasgow, a Northumberland man, the late Mr. James Robson, was busily at work on compression in this district. His first patent is dated 1877, No. 2,334. It describes an engine of the non-compression type; but he produced a two-stroke engine with compression, under patents dated 1879 and 1880. Messrs. Tangye, of Birmingham, produced an engine with Mr. Robson, which was first exhibited in public by them at the end of 1880.

Messrs. Sterne & Co., engineers, Glasgow, built and sold large numbers of Clerk type two-stroke engines, and Messrs. Tangye, of Birmingham, a large number of Robson engines. The test of use and time, however, proved the four-stroke engine to be best adapted for most purposes, and by far the largest numbers of internal-combustion engines in existence operate according to this cycle.

Many of the larger gas engines in Germany and America operate upon the Clerk modification of two-stroke compression engine as adopted by Messrs. Koerting, of Hanover, and their licensees. In the inquiry made in Germany referred to already, it was proved that 260,000 brake H.P. was produced in that country in the year 1907 by four-stroke engines, and 91,000 brake H.P. by two-stroke engines.

A modification of the Robson two-stroke engine was made in England by Mr. Day in 1891, in which a crank case was used as the pumping chamber, and the piston, by means of three cylinder ports, performed all the necessary valve operations. This form of engine is largely adopted in America for launch propulsion; some motor-cars also used it.

Five reports have been published by the British Association summarising investigations on the gas engine.

Germany has also carried out some investigations, and most valuable French work has been also done; some American work has also been performed, but undoubtedly the English work on the nature of gaseous explosions has proved of vital importance to the science of this subject.

While in Germany engineers paid great attention to larger cylinder engines, England was busy developing the smaller types adapted to use heavier oils, such as kerosene and paraffin. The first engine to attain success as a kerosene or paraffin engine was produced by Messrs. Priestman, of Hull, in 1885. Mr. Stuart Akroyd, in his patents of 1886 and 1888, described an engine which, in the hands of Messrs. Hornsby, has taken a most important position.

One set of experiments made by me at Messrs. Tangyes' works in Birmingham possesses special interest. No gas was added to the air until compression was complete. The engine was a flame-injection engine in which explosion was avoided altogether; it ran for six months and many tests were made. Five years later Dr. Diesel, the distinguished German inventor, began work on an engine in which he injected a fine oil spray into highly compressed hot air. The spray at once ignited, and a diagram very similar to the early Clerk diagram was produced, but at a much higher pressure with greater expansion, and therefore much greater economy.

The Diesel type of engine, with its high compression and automatic ignition, used for the first time very heavy oils in a most effective way. Although it has taken an important place, and will continue to occupy an honourable position, its advocates have rather exaggerated its possibilities. For stationary purposes undoubtedly gaseous fuel prepared from coal or carbonaceous matter will maintain the leading position.

Had coal gas been the only fuel possible for the internal-combustion engine, it could not have attained its position of to-day. In providing other gases for this purpose England led the way. Mr. J. E. Dowson constructed a gas producer, using anthracite, which he first exhibited operating a Crossley gas engine in the year 1881 at the York meeting of the British Association.

England, too, led in the use of bituminous fuel producers; the late Dr. Ludwig Mond devoted much effort to the production of large plants capable of gasifying bituminous fuels. In the larger plants devices were included for the chemical recovery of ammonia and the production of sulphate of ammonia, and many large installations of gas engines are now in operation up to about 3,000 H.P. using gas from Mond plant.

An English inventor, the late Mr. B. H. Thwaite, in 1895 made an important experiment in the application of the waste blast-furnace gas to the purpose of power production. His first plants were installed at the Glasgow Iron Works and at Barrow-in-Furness, and the idea was soon taken up at the great Belgian works of Messrs. Cockerill. There the large cylinder gas engine was first developed. The large cylinder movement has undoubtedly prospered more on the Continent and in America than in this country. The extent of the trade, however, is not very great compared to the trade in small cylinder engines.

Of the German inventors, Daimler's merit consisted in his appreciation of the high-speed four-stroke engine of small dimensions, and his little petrol motors were rapidly adapted by Germans, French, and Belgians to the purpose of motor-car propulsion. England, unfortunately, was hampered by an absurd law, which was not repealed until 1896, so that after that date Britain rapidly gained headway in the construction of the very small cylinder petrol engine, and its designers and scientific investigators shared fully in the modern development of the motor-car and the aeroplane. The aeroplane became practicable by the genius of the brothers Wilbur and Orville Wright in the United States in the year 1906. They were the first to successfully apply a petrol engine to a mechanical glider.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Economics and Trade.

In your issue of November 17th you referred in your Editorial to Mr. James Swinburne's lecture on "Science and Industry," and expressed surprise at his belief in "the truth and virtue of economic theory." I have read with pleasure from time to time your Editorials on the necessity for a new spirit after the war, but how is this to be realised unless the economic question is squarely faced?

Free Trade, the great fiscal fallacy of last century, is the fetish of a chosen few in our country. The rest of the world, and many of our best here, believe that wealth is due to production, and that to buy from abroad what you could produce at home at the same, or approximately the same, price under similar conditions, means the enriching of a few importers and some manufacturers to the detriment of the country generally.

The Free Traders' explanation of our inability to meet unfair competition is lack of education, but rather does this lack of education explain the foolishness of the electorate in allowing Free Traders to dictate the country's policy.

Producer.

Final-Grade Classes in Electrical Installation Work.

In the middle of our letter in last week's issue your compositor made us say that there were "*hundreds of thousands*" of individuals waiting for tuition. Our typed letter said "*hundreds or thousands.*"

This unfortunate slip converts our true statement into one of gross exaggeration, and affects the rest of our communication; so we should be obliged if you would insert this correction.

A. P. Lundberg & Sons.

December 1st, 1916, London, N.

[We regret the mistake, a typical "printer's error," but hope that it was obvious to the reader.—EDS. ELEC. REV.]

Paralleling of Electric Power Stations.

I really am at a loss to understand the necessity of papers being read on the enormous difficulties in the way of station engineers who are suggesting linking-up.

Paralleling of power stations has been in vogue in America for very many years without any very terrible disasters having occurred. For the last 12 years I have been running power stations in Sheffield paralleled at 2,200 volts, two-phase, and for the last five or six years I have paralleled with these a power station at 11,200 volts, three-phase. The only thing I have found necessary has been to put in a booster which operates either positive or negative on the interconnecter between the power stations, and there has never been any trouble whatever.

S. E. Fedden,
General Manager.

Electric Supply Department, Sheffield,
December 2nd, 1916.

Between Two Stools.

"Victimus" is not the only one suffering under "The Defence of the Realm Act." I myself was hauled up before the superintendent of a tramway company, for whom I had worked for 17 years, and told to my face that he took me for a German spy, and that I looked like a German. I retorted that I looked like what I am—a British North countryman. I produced a copy of my birth certificate, and he said that was, to him, merely a piece of paper. The superintendant of police was satisfied with my credentials, and wrote him to that effect. Several influential gentlemen in the town interviewed him on my behalf, but he would not withdraw his statement. I was discharged without notice. I have now been shift engineer at the municipal electricity works, in the same town, for the last 12 months, badged "On War Service," my employers knowing why I was discharged from the tramway company. It is evident that he (the tramway superintendent) has been made a tool of by some unscrupulous person.

Dunelmian.

Power Station Design.

Referring to your article of November 24th, suggesting the direct supply of coal to stoker hoppers from outside storage, this has long been practised in small and medium-sized boiler houses.

A simple monorail runs around the boiler house, carrying a series of suspended buckets, which are filled either from the coal pile or from outside bunkers, and discharged by gravity to stoker hoppers of the normal size; there is no power cost and no obstruction, and where headroom for overhead coal bunkers is lacking, this monorail system is both cheap and convenient.

The three-boiler plant illustrated in your "Notes" for November 17th, and shown more fully in *Power*, September 19th, 1916, has plenty of space for overhead bunkers holding several hours' supply, and thus giving continuous gravity-feed to normal-sized hoppers of stokers.

Instead of following this highly-desirable practice, the method adopted for this three-boiler plant is to use a bulky travelling crane, transporting back and forwards a single 2 cb. yard coal bucket, which probably holds only about one ton of small coal, and this one bucket has to discharge the coal to three gigantic hoppers, said to hold 55 tons of coal each. These huge hoppers are really bunkers in a very undesirable position, close to the fronts of boilers, with intermittent instead of continuous supply.

Apart from the undesirability of bunkers in such a position, it is clear that the great majority of boilers need front access to the tubes, and could not possibly store coal in bunkers obstructing the tube doors.

Scrutator.

November 30th, 1916.

[The American plant referred to was quoted by us as an example of modern design by such well-known engineers as Messrs. Sargent and Lundy; if the boiler type had been such as to necessitate front access to the tubes, no doubt the crane would have facilitated the dismantling of the hoppers, the arrangement of which was presumably adopted with good reason.—EDS. E.R.]

"Summation-watt" Capacity of Field Rheostats.

I heartily agree with the last paragraph of Mr. Boothman's letter in your current issue, in which he quotes words used by Mr. Carter, that "The use of a formula without care and intelligence is certain to lead, sooner or later, to disaster." My contention all along has been in accordance with this principle.

I note that for a 10-ampere, 20-volt machine the figures given by Mr. Boothman work out right; I quite agree with this, but would point out that such a machine is rather an extreme case. I had in mind, however, a potentiometer resistance used, for example, in conjunction with rotary converters.

I think if Mr Boothman will check my figures for such a rheostat, he will agree that they are correct.

Charles C. Garrard.

Birmingham, *December 2nd*, 1916.

Breakdowns of German Plant.

With reference to your leader and the article in the current issue under the above heading, as you invite additional illustrations of the failure of German plant, we have pleasure in giving you the following. This also relates to the Shanghai Municipal Council, but Mr. Aldridge evidently dealt in detail only with the turbo-alternators in making his report:—

In November, 1913, we secured an extensive contract for the installation of the extra-high-tension three-core cables (W.P. 11,000 volts) against very keen German competition. The actual installation of that cable was carried out between April, 1914, and December of that year, and during the progress of the work we had to withdraw and re-lay a considerable quantity of German cable which had given trouble. The principal cause of the trouble was the very inferior method of jointing extra-high-tension cables adopted by the Germans, and not owing to the construction of the cables. However, our engineer in charge of the contract, having an opportunity of examining the German cables, was of the opinion that the insulation was greatly inferior to that of British cables, and that the "life" of the German cables was not likely to prove anything near so long as a cable manufactured to the usual British standard. The jointing of the German cables was carried out solely with the object of getting the work through cheaply and quickly. The joints were made with a clamp fitting and grub screws, and the sweating of the joint, which British manufacturers consider to be essential, was entirely absent. The joints were not properly insulated or finished. They were not "staggered," and there was very little clearance between the cores. The German joints were merely encased in a cast-iron box of a very inferior design, which was filled with compound. Consequently the lead sheathing of the

cable was only dependent upon the stickiness of the compound for holding it in place against the strains of expansion or contraction or the movement of ground. The amount of work and skill required in the construction of such a joint as compared with the British-made joint is very small.

The following is a description of the usual method adopted by the British manufacturer :—

The conductor is first joined on the telescopic principle, by which the various layers of wires making up the conductor are cut to different lengths. On one length of cable the centre wire is cut shorter than the next layer, the wires in each succeeding layer to the outer layer being longer than the layer underneath them. On the other piece of cable the wires are cut in exactly the opposite manner, so that the centre wire is longer than the layers above it, and each succeeding layer is correspondingly shorter. Thus the conductors fit into each other in the manner of a plug and socket. The conductor is then tightly bound with fine wire, and the whole joint made solid with molten metal. After the conductors have been joined they are insulated with special tape to a thickness greater than the original diameter of the insulated cores.

Before commencing to make the joints in the conductors a sufficient length of the sheathing is cut away to permit of the joints being "staggered"—*i.e.*, made in different positions, so that no joint is directly alongside another. This, of course, entails more work in freeing the insulated conductors, and more material to re-sheathe the joint. After the joints have been thoroughly insulated, a lead sleeve, which must be of the correct diameter, and which has been previously slipped over one length of cable, is brought into position and properly joined by a plumber to the original lead sheathing by means of a wiped joint. Insulating compound is then poured into the lead sleeve through a hole left for the purpose, the hole being afterwards properly plugged and the joint further protected by means of an iron protecting box. This box is, of course, much bigger than the German box, owing to the much greater length of joint produced by the British method of "staggering" the joint.

We think that you are doing a good service to the British electrical industry by giving wide publicity to the flaws that undoubtedly exist in German plant. The principle of "good enough" is one which the Germans evidently adopt towards their customers, particularly customers abroad, so long as that principle will enable them to cut their prices low enough to get the order, and also make a much larger profit than their scrupulous British competitor. The general run of reputable British firms believe in giving their customers only that which would be good enough for themselves; and when buyers are tempted by an offer of something cheaper from abroad, it would be well for them if they remembered this fact.

W. T. Henley's Telegraph Works Co., Ltd.
W. Bishop, *Manager, Sales Department.*

London, E.C., *December 4th*, 1916.

How Electricity is Stolen in Shanghai.

I enclose the following letter, which is rather a gem in its way. It is written by an informant notifying this department that the man referred to in the letter has been stealing electricity for a number of years. Investigations proved that the consumer had, by an ingenious contrivance fixed on the door of his house, so connected the shunt-wire leading to the meter, that when the door was open the shunt would be in circuit and the meter registering, so that whenever the meter inspector called to examine the meter it would appear to be working in order. When, however, the door was shut, the shunt circuit was broken, and so the meter would cease to register. He had carefully concealed the connection where he had broken the shunt-wire behind a partition, and the two ends of the wire were connected on to a spring contact fixed behind the door.

In the past I had considerable difficulty and trouble with the older type of meters with the separate shunt connection, as the Chinese soon learnt that by cutting the shunt wire the meter would cease to register, but for several years now all the meters have had both main leads taken in and out of the meter with the shunt connection made inside the meter, which is sealed, consequently the opportunities for interfering with the registration of the meter have been reduced to a minimum. The case in point to which the enclosed letter refers was effected in an installation where the old type of meter, having an external shunt wire, was installed.

T. H. U. Aldridge,
Engineer-in-Chief and Manager.

Electricity Department, Shanghai,
November 13th, 1916.

[COPY.]

"Shanghai, *November 4th*, 1916.

"Mrs. S. M. E. Dept.
"To whom it may concern.

"Gentlemen,—Being informed truly that a Chinese named F. M. Tseou Who, who have had stolen your electricity for last 15 years in his house (F47, Bubbling Road); during that time the lamp of his house, about 14 lamps at 100 c.l. each lamp. They were perfectly whole, steal and the wires hid in the cealing; afterwords he knew somebody against him, thus made him fear to be caught, so he at once change all the 100 c.l. lamps into 50 c.l., and asked you put a watch, but still the lamps of his bedroom (down stairs east side) without throught pass the watch.

"Every day when night has came the dweeller will light the lamp and open the watch cork that was in vain, because he has put another cork in his sleeping bed (the wire from cealing) must open steal-cork first then got light. You will find and count his payment fee agree the watch or not. They are 14 lamps of 50 c.l. each, and every lamp lighting at sun sits time to next morning; this is you may inquir the dweellers.

"I am quite sure, he still in in stealing. I hope you will go and catch it as soon as possible.

"I am very true,
"Your faithfully servant,
"Richposmann."

LEGAL.

The Rating of Electric Tramways.
Appeal by the L.C.C.

(*Continued from page* 569.)

At the County of London Quarter Sessions, at Clerkenwell, Mr. A. P. Lawrie, K.C. (Deputy-Chairman), and another magistrate resumed the hearing of the appeal by the London County Council against the quinquennial assessment by the Assessment Committee of the Holborn Union of tramway lines in the Boroughs of Holborn and Finsbury. The thoroughfares in which the lines are situated include Clerkenwell Road, City Road, Gray's Inn Road, Rosebery Avenue, and Old Street.

Mr. Walter Ryde, K.C., and Mr. E. M. Konstam appeared for the County Council, while Mr. Clavell Salter, K.C., M.P., and Mr. W. J. Jeeves represented the Assessment Committee.

The facts showed that the rateable value fixed by the Overseers was £16,932, which was reduced by the Assessment Committee on appeal to £13,818, and the County Council now claimed that it should be further reduced to £6,960. This sum included £810, which had been agreed by the parties as the value of the Holborn electrical sub-station. The gross value had been fixed at £32,055, and the Council claimed that it should be reduced to £25,197.

Evidence was now given by Mr. H. Vorley, accountant for the tramways, who admitted, in cross-examination by Mr. Clavell Salter, that in the first six months of the current account year, down to the end of last September, the receipts showed an increase over the six months ended Michaelmas, 1915, of £134,937. The 1915 figures, however, included the strike period, during which the Council lost £100,000 in receipts.

Mr. Joshua K. Bruce, deputy chief officer of tramways, said the receipts per car-mile were lower in the Holborn Union than over London generally. The costs outside would probably be lower. Slow speed increased the cost of operating cars, and in consequence of the speed being much lower in the Holborn Union than on the remainder of the system, 17 more cars were required. It was the almost universal experience that as a company or public authority improved a tram route the more money was taken. The longer the route the better value per car-mile.

Mr. Donald Dinwiddy, president of the Rating Surveyors' Association, giving evidence in support of the appeal, said that in the recent quinquennial valuation he advised the Assessment Committees of the Boroughs of Stepney, Bermondsey, Camberwell, Deptford, Greenwich, Lewisham and Woolwich, and agreed the aggregate rateable value of the lines in those boroughs at £51,544. The receipts in those seven boroughs, according to returns given to him by the County Council, were just over a halfpenny per car-mile in excess of the average of the whole system. Witness proceeded on that basis, and he thought that any departure from it would lead to unutterable confusion. In regard to the receipts in the seven boroughs, he allowed a prospective increase of 5 per cent. because of the reduced 'bus competition. In his valuation of the lines in the Holborn Union, he took the total car-mileage for 1914-15 at 3,444,331, and the total receipts at £131,712. He added to the receipts a prospective increase of 5 per cent., equal to £6,586, making a total of £138,298. He calculated working expenses—power, traffic, general war bonus, &c., repairs and renewals—at 7·453d. per car-mile, and deducted ·049d. for advertisement receipts, leaving 7·404d. per car-mile, which gave a deduction of £106,258. He made other deductions, usual in such a case, and arrived at a rateable value of lines of £4,562. Witness added that on the principle he had adopted there was no danger of a part of the system being rated at a greater value than the whole. Departure from the principle would mean that the Council would be rated at a greater sum for the whole than the valuation of the whole showed.

This concluded the case for the County Council.

On behalf of the Assessment Committee, Mr. Clavell Salter submitted that the parochial receipts in the parishes in question must be assumed to be considerably in excess of the average of the system, which was 9·5d. per car-mile. He would call evidence to show that these routes were more lucrative at their London end than at their northern and north-eastern ends. No rating Court was ever excused from making the best estimate it could by reason of the fact that the materials before it were scanty and unsatisfactory. Rating, he believed, meant estimating; the whole basis of the thing was estimate; and he suggested that the Court should make such an addition to the figures arrived at by the County Council as would give what the Court considered to be the actual receipts in each parish.

Mr. W. H. Eve, surveyor, of Union Court, E.C., gave evidence in support of the assessment, and arrived at a rateable value considerably in excess of that fixed by the Assessment Committee.

He had added 1½d. per car-mile to the average receipts of each route, and applied the amount thus reached to the parishes in question, on the ground that the earnings of the tramways in the Holborn Union were greater than on the routes outside. There were many halfpenny fares in the union on a basis of a higher rate than outside.

The DEPUTY-CHAIRMAN: I think it is an important point that higher fares are paid where passengers are scarce.

MR. E. M. LACEY, consulting engineer, of Westminster, also gave evidence on behalf of the Assessment Committee. In cross-examination, he said he thought £70 or £80 would be a fair figure to allow for the repair of a car on the conduit system. The Manchester and Salford systems were the nearest parallel in this country to the London cars.

MR. RYDE: Your renewal fund is much below what the Council has actually spent. Here we have rails which have only been down three or four years, and yet we have largely exceeded your estimate.

MR. LACEY: Some years you spend more than in others in renewals. Most of the rails have some years of life yet. The witness added that he did not think there was much difference on the question of lives between him and Mr. Welling, the permanent way engineer of the tramways.

MR. RYDE: Have you fixed your renewal fund on the basis that you can renew steel rails at £7 per ton?

MR. LACEY: £7 a ton was much above the average of the previous seven or eight years, and much above the average the County Council have paid for their rails. I am prepared to admit that steel prices may not go back to the normal for some considerable time after the war; on the other hand, they may. Owing to the better organisation of our works generally throughout the country, we may be able to produce at a cheaper rate in spite of increased wages.

In further cross-examination, MR. LACEY said he thought the average life of the rails in the Holborn Union would be about 14 years.

MR. RYDE: Mr. Welling's figure is 10·6 years. Do you know that 53 miles out of the 279 miles of track have already been renewed?

MR. LACEY: I don't know whether it is so or not. If one-fifth has been renewed in 11 years, it rather supports my average.

MR. RYDE: You know all the lines were not laid at the same time.

The WITNESS said he had taken the life of the cables as 35 years, though he had not had a cable lasting that length of time in his experience, and probably few people had. He did not know the age of the oldest electrical cable now in existence, but some he laid in 1894 were still in existence.

MR. RYDE: Then that must be a real estimate on your part.

MR. LACEY: It is an estimate based on this: Tramway cable laid, as this is, in ducts, is laid under the best possible conditions. We are in the habit of taking 25 and 30 years for ordinary electric light cables. If it is fair to do that, it is certainly fair to take 35 years for a tramway cable laid under these conditions.

MR. RYDE: Has a cable laid solid a longer life than if laid in ducts?

MR. LACEY: Not necessarily. I should give a cable laid in ducts a longer life.

MR. RYDE: Isn't the installation much more perfect when laid solid?

MR. LACEY: Certainly.

After sitting for a further three days, the Court adjourned the hearing of the case till December 12th.

FRASER & CHALMERS, LTD., *v.* WHITECROSS CO., LTD.

MR. JUSTICE ROWLATT had before him this adjourned case, which involved a claim by the plaintiffs for £4,186, as the price of a No. 3 Bettington boiler, two pulverisers (one driven electrically and the other by steam turbine), and auxiliary parts sold to the defendants under contracts of 1913 and 1914, and erected at the defendants' wire-drawing works in Lancashire. There was a big counterclaim against Fraser & Chalmers, Ltd., by the defendants for £8,000 by reason of alleged delay and failure by the boiler to produce the guaranteed results. The case was begun on July 3rd and adjourned, the arrangement being that the boiler should be removed pending the resumed hearing, and it was now announced that the boiler had in the interim been sold for £3,000, of which sum £750 was agreed to be the minimum profit of the plaintiffs. The plaintiffs now proceeded to call technical evidence in support of the claim. The case was of a very technical character, but it appeared, broadly, that the plaintiffs supplied the boiler to be used in conjunction with a Green's economiser to evaporate 40,000 lb. of steam per hour, and there were detailed stipulations as to efficiency. There were many accidents and difficulties incidental to the experimenting with the plant, and Fraser & Chalmers said that ultimately the defendants declined to allow them to proceed further in regard to putting the boiler into fit working order, and rejected the plant, and called on the plaintiffs to remove it. The defendants alleged substantially that the boiler never produced the guaranteed results, and was useless for their purposes.

Mr. Colefax, K.C., and Mr. Moritz were for the plaintiffs, and Mr. Leslie Scott, K.C., and Mr. Podden represented the defendants.

MR. CHAPMAN, of the plaintiff firm, said he had had a great deal of experience with Bettington boilers, and had held a position for the firm at Johannesburg. Mr. Chapman subsequently described in detail the experiments with the boiler after its erection at Warrington.

A large body of expert evidence was called on both sides.

Eventually, after a hearing covering several days, MR. JUSTICE ROWLATT gave judgment in favour of the plaintiffs. He held that the plaintiffs were entitled to recover as damages the difference between the contract price and the net sum received by them for the sale of the boiler, deducting therefrom the cost of erection, if it fell on them, and there was also a sum of £4 14s. 6d. that was not in dispute. The parties must agree with the figures, and he gave the plaintiffs judgment for the sum determined, with costs.

MUNITIONS CASES.

AT a Munitions Tribunal, held at Stockton-on-Tees last Friday (December 1st), two electricians, John Harkness and Hubert Sidgwick, employed at a local ironworks, were charged with having refused to obey the orders of their foreman. T. E. Brannigan, a foreman electrician, said that on November 25th the two defendants refused to go into the sulphuric acid plant, stating that they had received instructions from their society not to do so. He asked them if they would do the work under protest, but Harkness said they had complained on many occasions, and they were willing to take the consequences, as they had their Union behind them. Brannigan, in reply to a Trade Union representative, denied that the men would come into contact with the acid or the fumes. He also denied that he had received complaints from the men about their boots and clothing being burnt by the acid. The defendants said the grounds for their refusal were that they asked for a special allowance for damaged clothes and the dangerous nature of the work as regards health. The Trade Union representative said the men had not received any instructions from the Union to refuse to do the work, and the Tribunal decided that the men had refused to comply with a reasonable order, and would have to pay 15s. each.

At Edinburgh and District Munitions Tribunal a boiler-house fireman employed in Leith Corporation Electricity Supply Works was charged with having, on November 3rd, at 11.30 p.m., left his work in defiance of instructions. It was submitted that the man's action might have resulted in the total or partial stoppage of the steam supply for the generating plant. The man said he left his work because he had too much to do. A fine of £1 was imposed.—*Glasgow Herald.*

BRITISH POWER, TRACTION, &C., CO., LTD., *v.* HODGSON.

MR. JUSTICE PETERSON, in the Chancery Division, had before him, on Monday last, the summons in this action, by which the plaintiffs sought to enforce a finding of the Master that the defendant was liable for a sum of £7,000 odd.

MR. HUGHES, K.C., for the plaintiffs, reminded his Lordship that by a judgment of November 6th it was directed that the liability was incurred by fraud or fraudulent breach of trust, and was, therefore, not liquidated by the defendant's bankruptcy, but directed that the order should not be drawn up, as there was a pending summons to extend the time for applying to vary the Master's certificate. The defendant had decided not to proceed with the summons, and he (counsel) therefore asked that an order should go in accordance with his Lordship's judgment, that the defendant should pay into Court a sum of £7,653, with interest at 4 per cent. from June 25th, 1909, the date of the Master's certificate. He also asked that the defendant should be ordered to pay the costs of the summons.

MR. TOMLIN, K.C., for the defendant, said that the plaintiff company was in liquidation, and the action was really by creditors, and the defendant had issued a summons in the winding-up to set aside the judgment. The defendant was also intending to appeal against his Lordship's judgment on the present summons and he asked for indulgence. It was a matter that had been in suspense for nine years, and he asked for a stay pending the appeal, at any rate. Notice of appeal would be given as soon as the order was drawn up.

MR. JUSTICE PETERSON suggested that some security for payment of the money should be given.

MR. TOMLIN said he was not prepared to give security. All he asked for now was a little time. It was impossible for his client at the moment to put his hand on nearly £8,000.

His LORDSHIP asked whether the defendant was prepared to pay a substantial sum into Court.

MR. TOMLIN said he could not make any offer of the kind, and must place himself in his Lordship's hands without prejudice to any application he might make to the Court of Appeal.

His LORDSHIP said that, under the circumstances, he would give the defendant six weeks. There would be an order upon the defendant to pay the sum found due on the Master's certificate into Court within six weeks, with interest, and an order on the defendant to pay the costs of the summons.

BRITISH THOMSON-HOUSTON CO., LTD., *v.* DURAM, LTD.
TUNGSTEN WIRE PATENT LITIGATION.

MR. JUSTICE ASTBURY in the Chancery Division commenced on Monday the hearing of an action by the British Thomson-Houston Co., Ltd., against Duram, Ltd., for an injunction to restrain the defendants from infringing the plaintiffs' patent No. 21,513 of 1906, for the invention of a "Process and apparatus for the treatment of metallic tungsten, and for the manufacture of electric lamp filaments therefrom," and also their patent No. 17,722 of 1911, which was granted to John Thomas Henry Dempster for an invention of improvements in methods of wire drawing. It was alleged in the case that the defendants had manufactured wire in accordance with these inventions, and sold three spools of pladuram made according to the same to the General Electric Co., Ltd. Defendants

said the patents were invalid, and denied infringement, and said the processes and manufacture had, since the patent of 1906, been carried on mainly outside the United Kingdom—namely, by companies in America, Germany and Holland.

Mr. A. J. Walter, K.C., Mr. Colefax, K.C., and Mr. J. H. Gray appeared for the plaintiffs, and Mr. Tom Terrell, K.C., Mr. Kerby, K.C., and Mr. C. Terrell for the defendants.

Mr. Walter said the patent of 1906 was generally known as relating to tungsten drawn-wire, and that of 1911 related to improvements in the drawing of the wire. It had been suggested that if tungsten could be drawn into the form of wire it would be of great value, but, until the patent in question in this case was developed, nobody knew how to do it at all. He claimed for the plaintiffs' invention that it treated coherent tungsten by heat during its working process.

Mr. James Swinburne, the well-known expert, gave evidence. The case is proceeding.

Accident Claim.

At the Manchester Assizes, on November 28th, John Clifford Seddon, electrician, Great Lever, Bolton, obtained £318 damages for injuries received in an accident at Worsley, near Manchester, when a steam motor-lorry belonging to William Hesford, carrier, knocked him off his bicycle and broke one of his legs.

WAR ITEMS.

Controlled Establishments.—The number of establishments now controlled by the Ministry of Munitions is 4,512.

Exports to China.—The "London Gazette" for December 1st contains a number of additions to the list of those to whom exports to China and Siam may be consigned.

Lighting Prosecution.—According to the "Westminster Gazette," Mr. J. K. Brydges, the borough electrical engineer, was fined at Eastbourne on December 1st for having a brilliant light at his residence. The Mayor reprimanded the defendant.

Flashlamps and Air Raids.—The public in the Keighley and Bingley district are being warned by the police that the use of electric flashlamps in the streets after it has become known that an air raid is in progress in the country is illegal.

Lost Time.—We read in a Manchester paper that Sir William Clegg, in reviewing the doings of the Sheffield Munitions Tribunal, deplored that during November the number of hours lost by workmen who had been before the Tribunal was 30,923, as compared with 23,412 in October.

Disabled Soldiers and the Post Office.—The Postmaster-General says that the number of disabled soldiers anxious to obtain situations in the Post Office is likely to be greatly in excess of the vacancies, and he is bound to reserve places for Post Office servants now with the Colours.—*The Times.*

To be Wound Up.—The Board of Trade has ordered the following to be wound up:—

Vincit Co., Ltd., Apollo Works, 21, South Road, New Southgate, London, N., agents for the sale of carborundum and electrite machinery. Controller: C. Eves, 62, New Broad Street, London, E.C.

Canadian Trade.—The "Morning Post" states that the Canadian Government is appointing a Commission to conduct an investigation into the methods of scientific development of Canadian industries after the war. The matter is in the hands of Sir George Foster, the Minister of Trade and Commerce, who has given considerable attention lately to the apparent need of scientific co-operation in many of the principal Canadian industries. The Commission consists of nine members.

Schaffer & Budenberg.—Mr. Barnes having inquired in Parliament whether the firm of Schaffer & Budenberg, with headquarters in Nuremberg and a small works in Manchester, are on the list of Government contractors, and whether the agent, "a full-blooded German," is allowed to go in and out of the Clyde shipyards in pursuit of his business, Mr. Tennant answers: I am informed that the affairs of this firm have been investigated by the Board of Trade, that the shares have been vested in the Public Trustee under the Trading With the Enemy Amendment Act, 1914, and that they are still on the list of Government contractors. The second part of the question probably refers to the Glasgow manager of the firm, who is of German origin, but was naturalised as a British subject nearly 40 years ago.—*Morning Post.*

The Armorduct Manufacturing Co.—In the Parliamentary answers last week, says the *Hardware Trade Journal*, Mr. Pretyman said the business of the Armorduct Manufacturing Co., Ltd., had not been wound up, because the Advisory Committee recommended that, having regard to the character of the work being carried on by the company, that course was inexpedient. Efforts were being made to negotiate a sale by private treaty to some British purchaser who would continue the work satisfactorily, and, pending the result of the steps which were now being taken to find a purchaser of the business, he was not prepared to say what conditions of sale would be imposed. An offer had been made by Mr. Small, but it had not been accepted.

From the *Times* Parliamentary columns we learn that Mr. Pretyman, replying to questions asked by Mr. Nield concerning "the German firm trading as the Armorduct Manufacturing Co." and an offer made by "Mr. Small or Schmahl, the former manager and nominee of the German owners," said:—The supervisor of the Armorduct Manufacturing Co is at present in communication with several British firms with the view of obtaining offers for the business, and pending the result of the negotiations I am unable to say what consideration will be given to the offer made by Mr. Small. The difficulty in offering the business for sale by auction is that it is necessary that the purchaser should continue the business satisfactorily. The Armorduct Co. is manufacturing articles which are required by the War Office and Ministry of Munitions of War in the national interest, and the supply of which might be diminished by closing the company's business. Mr. Butcher asked that care should be taken that the business should be sold to a British-born subject. Mr. Pretyman said that consideration would be borne in mind. The business would be dealt with under the usual regulations, which provided that any portion of the profits of the undertaking which would accrue to enemies would be vested in the Public Trustee.

Exemption Applications.—The Aldershot Tribunal, on November 29th, reviewed cases of employés of the Traction Co., the Military Representative applying for withdrawal of certificates of conditional exemption. In 10 cases exemption was allowed to stand; in another three months' exemption was substituted; three were granted to January 1st for substitution; and in another case two months were conceded. The company made other appeals, with the result that conditional exemption was allowed to an inspector on the ground of certified occupation; three months to a foreman engine fitter, one month each to two drivers for substitution, and to January 1st to a fitter and two drivers for substitutes to be found.

Southend T.C. appealed for four tram drivers, aged respectively 33, 35, 37, and 40, and a conductor and pointsman (40), it being said that it was impossible to fill the places. Col. Newitt intimated that he could not consent to the men being marked as in certified occupations. Two of the drivers were thus classed by the Tribunal, and the others were given conditional exemption.

The County Tribunal has given exemption to March 31st to a charge engineer at the city electricity works at Gloucester, passed for general service, and stated to be absolutely indispensable and impossible to be replaced.

At Swinton (Lancs.), an electrician, aged 41, passed for C1, appealed, and stated that he did work for a munitions firm; two of his men had joined the Army. Two months' exemption was conceded.

Mirfield (Yorks.) Tribunal has given six months' exemption to the manager of a local electric motor works (40).

At Windermere, an appeal for absolute exemption was made by Mr. J. K. Thornborough (34), electrical engineer, who said that the whole of the permanent staff, and the junior partner, had been called to the Colours. The Military Representative consented to three months' temporary exemption, but the appeal was respited for a medical examination.

At Barnsley, on November 30th, the Barnsley & District Electric Traction Co. appealed for a clerk and cashier (29), a fitter (31), an armature winder (24), and a tram driver (25). The latter, the manager said, had left the company's service, and he had returned the man's exemption card. The clerk and cashier and the armature winder were conditionally exempted; and in the case of the fitter, the matter was deferred for two months for the Military Representative to endeavour to find a substitute.

Exemption to the end of the year has been granted to Mr. A. Howard (32), electrician, of Chingford (Essex).

Bromley (Kent) Tribunal has refused exemption to Mr. A. C. Edwards, electrician, of Widmore Parade, who failed to appear in support of his appeal.

At Gillingham (Kent), Mr. A. C. Chalmers, borough electrical engineer, appealed for C. W. Wharby (28), engine fitter's assistant, and three months were granted.

Herts Tribunal has refused exemption to Mr. W. Meager (35), electrical engineer, of Potten End, Berkhamsted, appealed for by Mr. A. E. Barron.

At the request of the Recruiting Officer, the Torquay Tribunal has unstarred Mr. G. A. Binnie, an electrician, passed for general service, and who has been engaged on munition work.

Before the City Tribunal, the Worcester Electric Traction Co. appealed for two switchboard attendants, S. A. Stallard (18) and A. Bullock (38), on the ground that they were in a certified occupation. The Advisory Committee assented to one being exempted, and Bullock was given a conditional certificate and Stallard until December 31st final.

At Oxford, further exemption until a substitute is found was appealed for by Mrs. Elizabeth Storey, electrical engineer, for S. A. Stock (24). Mrs. Storey stated that her husband died six months after the outbreak of war, and all her staff had enlisted with the exception of Stock, who had had five months' exemption. Lieutenant Whatcoat informed the Tribunal that there was not much chance of getting a substitute if Stock was an electrician. Mrs. Storey had had eight months, and it was not fair to ask the Military at the last moment to get a substitute. Stock said that he did not claim to be an engineer, but he could do most electrical work. Lieu-

tenant Whatcoat said the man would be most useful either in munitions or in the Army. The Chairman: The facts are that the lady's husband died after the war and this was the only man left to carry on the business. It was really an employer's application, and was a hard case. Lieutenant Whatcoat said that they were nearly all hard cases now. Unfortunately this man was skilled, and would be useful in either munition works or the Army. Six months were allowed.

At Deal, Messrs. T. L. Tapper, Ltd., appealed for M. C. Strevens (28), electrician, the only skilled man left. The appeal was out of time, but it was urged that as Mr. Tapper had been away on service from the beginning of the war the firm had a reasonable excuse for not applying before. The Tribunal decided that the appeal was too late, and that on its merits they would not entertain it.

The Birkdale (Southport) Electric Supply Co. appealed to the Liverpool Appeal Tribunal against the decision of the Local Tribunal in the case of D. C. Reilly, aged 20, single, and described as a switchboard attendant. The Southport Tribunal had allowed to December 1st only, and the Appeal Tribunal, in extending the time for one month, refused leave for a further appeal.

CONSUMERS' COMPLAINTS.

By A. T. BULLEN.

In a recent issue of the *Daily Mail*, the writer was surprised to find a letter from a well-known society lady, complaining that, in spite of the "Daylight Saving" Act, her consumption of electricity for lighting had increased—or, perhaps, it would be more correct to say that her bill for electricity consumed had increased—and she invoked the aid of the *Daily Mail*, first, to expose this incredible state of affairs; and, secondly, to search for some cause for the increase.

The only advice that the paper could possibly give, was that the lady in question should forward her complaint to the supply authority concerned, when no doubt an excellent reason could be given for this increased charge; or if, on the other hand, the bill proved to be unfair to the consumer, the matter would speedily be adjusted to the satisfaction of all the parties concerned.

Consumers, however, as a whole, do not appear to have such faith in the officials of the supply corporation or company as seems desirable. One of the first principles of business seems to be to cultivate distrust of everyone with whom you have dealings, and that is why a dissatisfied consumer will complain to anyone and everyone except only those persons appointed specifically for the purpose of giving him the satisfaction he seeks.

Naturally one searches for an explanation for so curious a condition, and wonders if the real reason is that those who have the settling of complaints do not, by their mode of action, ability, and manner of address, inspire confidence. Certain it is that it is quite impossible to deal satisfactorily with any consumer unless he or she is confident that the advice you are giving is sound, and that your knowledge of the subject is complete.

Perhaps more dissatisfaction and distrust is created by advice given by incompetent persons, the results of which have afterwards to be rectified, than by any other cause.

Generally speaking, people do not mind paying for a thing if they know that they are getting the genuine article, but no consumer likes paying for a quantity of electricity until he is quite sure that he has used it. For this reason the minimum charge enforced in some places, quite legitimately and even of necessity, never was, and never will be, popular, and so long as consumers feel that it is possible for an electricity meter to go wrong, or for a meter reader to make a mistake, just so long shall we have complaints.

It is quite possible that the society lady mentioned above had just cause for complaint, but it is equally probable that some satisfactory explanation of the increased charge could have been given had she sent her complaint to the proper quarter. First, it is more than probable that, owing to war conditions and an increased cost of production, the price of electricity had been raised by 20 per cent. Secondly, it is likely that this lady's house is usually closed for the greater part of the summer, but this year being an exceptional year, may have kept the consumer, or her servants, in residence for a longer period than usual.

Again, there is the possibility of alterations in the existing installation; the substitution of lamps of higher candle power, for instance. The dates between meter readings may not have covered similar periods last year and this year, giving in the first case a relatively short quarter and the second a comparatively much longer quarter. The system of charging may have had an effect, the maximum demand, perhaps, being higher, or there may previously have been in circuit a defective meter, and finally the meter reader may have made the mistake now of over-reading, or, at the corresponding time last year, the error of under-reading, or the meter may have been over-registering.

Surely out of all these possibilities something definite might have been gathered, but it could only be done by an official on the spot, who would have made a personal investigation.

The investigating official, however, must be very tactful in his researches, and must be careful to give only such information as is necessary and advisable. For instance, you might get a complaint over a trifling occurrence which may happen once in a thousand times, but it would be fatal to divulge the exact nature or cause of the failure, for you would immediately be overwhelmed by dozens of others anxiously inquiring lest a similar accident might befall them.

Here is a case in point. A certain consumer who has a thermal maximum-demand indicator on his motor circuit, noticed one day that after the meter reader had tipped his indicator it did not commence again at zero, because at the time of tipping the motor was actually working. He immediately made a complaint to the effect that his indicator was out of order. The cause of the complaint was, of course, obvious, but the investigating official could hardly explain the matter, for he would then have had to make special arrangements for tipping the indicators on every motor circuit in the town. Yet how often would the meter reader drop on a motor which was running at its maximum load?

Here is another instance which also concerns the maximum-demand indicator. In a certain town in the South of England an organist at one church was appointed to another in a different part of the town. The organs in both churches were blown electrically, but the first was on a direct current and the second on an alternating supply. The organist was surprised to find that it cost him much more to blow his new organ than it did the old one. Both circuits had maximum-demand indicators, and the explanation was, of course, the fact that on the A.C. circuit the thermal-demand indicator did not allow for power factor. Consequently the proportion of high-priced units was much more than in the case of the D.C. circuit. Yet it was hardly possible to explain this to the organist.

The remedies adopted in settling some complaints are amusing, yet these amusing methods are usually the outcome of delicate handling and often a keen sense of humour, which, by the way, is a very great asset in any consumers' department. The following is a really good incident. In the early days of the metal-filament lamps many consumers were advised to install small transformers to bring their voltages down to useful proportions. Some supply authorities went a step further than advising, and themselves installed these transformers. This was done in the present instance, but one night for some reason the voltage on one particular circuit was very low, and an old gentleman, who himself knew a little of electrical matters, was distressed to find that his light was poor. After that night he was continually complaining to this effect, and he fixed the responsibility on the transformer which had been installed. Tests were taken on several nights which proved that the voltage at the consumers' terminals was well up to standard, but nothing would convince the consumer that this was so. He was therefore advised to do away with the transformer, but when he realised that this meant purchasing new lamps, he would not think of it. "The transformer," he said, "belonged to the company, and they must supply him with a satisfactory one."

The difficulty was solved by a near neighbour of his removing when the company's inspector adopted the ruse of

changing the dissatisfied consumer's transformer for an identical one which was installed in the now empty house. From that day to this no complaint of bad light has been received from this quarter, and even the chief engineer of the company does not know the ultimate means adopted to satisfy this hitherto dissatisfied consumer.

Most complaints originate out of the charges made for electricity consumed, and most supply authorities now have properly equipped testing departments, under the supervision of a competent and experienced official, in order that the number of defective meters, and consequently the number of complaints, may be kept at a minimum. It is not sufficient, however, for the supervising official to confine his attention to the test-room. He must move among the consumers, and learn the conditions under which each one is using electricity.

In dealing with complaints he must be sympathetic, and ready to hear the consumer's whole story. He cannot settle things if he is in possession of only half the facts; but, on the other hand, his sympathy with the consumer must be tempered with common sense, so that he will not raise false hopes, which will be immediately dashed to the ground when his report reaches the chief engineer.

He should have a sound technical knowledge, but he should not air it to the consumer, except in such a manner as is likely to inspire confidence. It is of no value to talk over the head of the consumer; you must rather come down to his level, and try to explain things to him in language he can understand. At the same time, you must let him see that you have the knowledge to apply at the right time and in the proper place.

Remember, it is easy to presume upon the electrical ignorance of the consumer, but it does not pay in the end.

Above all, it is necessary to be fair. If the supply authority is in the wrong, the point should be gracefully conceded, and the matter immediately rectified. Mistakes will always occur—it cannot be helped; but the method of correction of these mistakes may mean much for the future welfare of electrical undertakings.

The officials of a consumers' department are, in one respect, unlike most other men, for they can serve two masters. They owe one duty to their employers, the supply authority; but they owe another duty to the consumers, for they are the guardians of their interests. Let them take care that they are just stewards.

BUSINESS NOTES.

Industrial Developments in Russia.—Some notes on this subject, prepared by the British Vice-Consul at Moscow, appear in the *Board of Trade Journal*. He states that the war has compelled Russia to develop her own chemical industry, and a certain number of works have already been erected while many are projected. The mobilisation of Russian industries in 1915 also affected the glass industry which was called upon to produce for the military authorities goods that were formerly imported from abroad, *e.g.*, mirrors, lenses, and other supplies for optical instruments, thermometer tubing, &c. Fair progress was made in the manufacture of insulating glasses for electrical purposes. There is a great demand for microscopes, scientific apparatus, field glasses, &c. Russian industry in these products is undeveloped as there are no specialists or experienced hands available. Surgical instruments form quite a new industry in Russia, and its development has been greatly handicapped by the shortage of instrument steel and suitable machines and appliances. Cold stores have a great future in Russia, and after the war there should be an excellent demand for refrigerating machinery. There is also expected to be a good opening for peat-pressing machinery. The motor-car business is being developed and large orders have been placed with Russian works to assist to that end. So far the bulk of motor-cars in use in Russia has been imported, imports in 1913-14 being valued at, roughly, £1,300,000.

Electrical Industry in India.—We quote the following editorial comments from a recent issue of *Indian Industries and Power*:—

"Of all the varied departments of commercial enterprise in India, perhaps the one most in need of immediate overhauling is the electrical industry. British manufacturers of electrical equipment have to realise that if they wish to retain what little hold they have of the Indian market, they must consider their position and prospects. Organisation in the full comprehensiveness of the term is what is needed. Not a mere associative collection of engineers. Organisation which works on the basic principle of mutual co-operation. Organisation that is real and capable of subordinating private interests to general ends. As far as we are concerned, organisation that is able to evolve an understanding of the needs of India, who is to-day ready to buy what she wants, but not always ready to take just what the manufacturers have to sell. One of the first problems that an association, founded on the above principles, would have to tackle is the question of 'standardisation.' Electrical engineers in India have long watched, not without impatience, the pathetic and half-hearted attempts made in the past to handle this proposition. If a firm grip of the market is to be obtained this indispensable condition must be achieved, for 'standardisation' is the very soul of organisation. If, as is most probable, private and immediate interests have to suffer, then they must go. Nothing should be allowed to stand in the way of the accomplishment of this end, which can only be attained by collective co-operation. There are many other points in this connection that will readily present themselves to those who are interested in the electrical industry, not the least important of which is the question of internal discipline. Pressure should be brought to bear on manufacturers who go out of their way to ignore trade standards, and spend considerable time in evolving means of getting behind regulations, avoiding control, and adopting illegitimate means of getting business. Stern measures must be adopted to force these men into line, for their operations not only have an adverse influence on the market, but tend to stultify the natural development of trade. Although attempts have been made in the past in India to bring electrical engineers and contractors into line, no real progress has been made, and what may be termed cut-throat methods have not infrequently been resorted to. This is good neither for the individual contractor nor for the trade. It is, perhaps, too much to expect celestial conditions to obtain in India, but if some such cohesive measure as that indicated could be adopted by British contractors in India the benefit would soon be apparent. The Americans and the Japanese are watching developments very closely, and although the imports from Japan are very inferior to the electrical exports of the United Kingdom, they are finding markets in India by virtue of the pushfulness and thoroughness of the methods employed by the Japanese agents here. Neither Japan nor the United States can hope to hold all the customers they are now securing, but the British firms will find that it will be an uphill fight before they can effectively oust them from the market. It seems to us that we are too prone to excuse our inactivity by that ready reference to the war and the procrastinating cry: 'Wait till the war is over.' The present upheaval should surely bring us to a reconsideration of this attitude. We have now to realise that old conditions have gone, never to return. What the future holds, none can foresee. We are for the moment concerned with the present, for from our present action future prospects will be determined. In order to keep and increase our hold on the sale of electrical machinery and accessories, we need primarily to focus all our energy on one object, the most powerful factor in our armamentarium of trade resource—organisation."

Catalogues and Lists.—British Westinghouse Electric and Manufacturing Co., Ltd., Trafford Park.—New Christmas Gift Catalogue, entitled "Domestic Helps." We suppose that, in keeping with the economical spirit of war-time, a far higher percentage than usual of the Christmas and New Year gifts of the coming month will be of a useful character. Everything that is in any way wasteful must be very definitely at a discount in these times. Therefore this catalogue of goods, which make both for economy, efficiency, convenience, and utility, as well as, in some measure, making their response to the desire for novelty, should be very acceptable. It consists of 16 pages of illustrations, prices, and brief particulars of electric cooking appliances, from the small disk stove to the large cooker, hot-bar fires and electric irons, shaving pots, kettles, stoneware utensils, the Westinghouse Utility motor, fans and hair dyers, and vacuum cleaners, also electric lamps and table standards.

Messrs. Jenson & Nicholson, Ltd., Goswell Works, Stratford, London, E.—New pamphlet giving particulars of "Lacwatt" and "Coilac" insulating varnishes, compositions, enamels, and other electrical specialties made at their works at Stratford. The firm have made a special study of the subject of electro-insulation.

The Electrical Alloy Co., Morristown, New Jersey, U.S.A.—Circulars relating to their resistance materials, Monel metal, and Spark Point nickel.

Trade Announcements.—Messrs. James Gordon & Co., water-power engineers, having had their offices in Canada House, Kingsway, requisitioned by the War Office, have removed to temporary offices at Queen's House, Kingsway. Their telephone number and telegraphic address remain the same.

The address of Messrs. Henry Faija & Co., Portland Cement Testing Works and Chemical Laboratories, is 6, Earl Street, Westminster, S.W. Though notice of the change was issued a year ago, letters continue to go to the old address.

Bankruptcy Proceedings.—E. W. Barton Wright, electrical therapeutic expert, Acton and Oxford Street.—Receiving order made at Brentford, November 24th, on a creditor's petition.

Australian Inquiries.—The Board of Trade Department of Commercial Intelligence reports the following inquiries received:—

A firm dealing in electrical goods seeks agencies for British firms for such goods other than wires and cables, telephones, bells, &c., instruments, circuit breakers, accumulators, and switchgear.

A manufacturers' agent wants to represent British makers of electrical fittings and accessories.

Dissolutions and Liquidations.—Ideal Battery Co., manufacturers of dry batteries and electrical appliances, Nursery Road, Mitcham, Surrey.—Messrs. B. Pearse, A. M. Foster and A. R. Harwood have dissolved partnership. Mr. Harwood attends to debts, &c.

Turner & Burger, 149, Farringdon Road, London, E.C.—Creditors must send particulars of debts, &c., to the Controller, Mr. J. E. Percival, 6, Old Jewry, E.C., by January 6th.

Feld Bros. & Co., Ltd., 326, Goswell Road, London, E.C.—Creditors must send particulars of debts, &c., to the Controller, Mr. J. E. Percival, as above, by January 6th.

"Dac" Accumulator Syndicate, Ltd.—This company is winding up voluntarily, with Mr. H. C. Bound, 61 and 62, Lincoln's Inn Fields, London, W.C., as liquidator. A meeting of creditors is called for December 15th.

Bachelet Flying Train Syndicate, Ltd., Bachelet Shipbuilding, Engineering and Ordnance Co., Ltd., Bachelet Levitated Railway Syndicate, Ltd., and Bachelet Shuttle and Loom Co., Ltd.—Creditors of these companies must send particulars of their debts, &c., to the liquidator, Sir W. B. Peat, 11, Ironmonger Lane, E.C., by January 3rd.

Quarz-Lampen Gesellschaft, M.C.H. (original Quartz Lamp Co.), 62, Red Lion Street, E.C.—Claims must be sent to the Controller (Mr. R. W. Brown, 12, Old Square, Lincoln's Inn, W.C.) by December 16th.

Private Arrangements.—The Tyler Apparatus Co., Ltd., Banister Road, North Kensington, London, W., electrical engineers, &c.—A circular has been issued to the creditors of the above, dated November 22nd last, by Messrs. Corfield & Cripwell, accountants and auditors, of Balfour House, Finsbury Pavement, E.C., which states that the petition presented by a creditor for the winding up of the company was withdrawn under an Order made by the Judge, and the course is thus clear now for the company to proceed with the reorganisation as suggested. At the meeting of creditors of the company, on November 3rd, 1916, at the Institute of Chartered Accountants, a scheme for the reorganisation of the company's affairs and for the payment of its debts in full, was laid before the creditors and approved. This has been further elaborated and laid before the Court of Chancery in Chambers, and has been allowed by the Court, in so far that the Judge ordered a formal meeting to be called under the terms of the Companies Consolidation Act, 1908, to formally consider and adopt the above scheme, and this was held on Tuesday last.

The Electrical Stores will, on December 12th, remove to 35/37 and 39, South Sherwood Street, Nottingham.

Book Notices.—*Air* is the title of the official organ of the Aeronautical Institute of Great Britain, of which the first number has just come to hand; its purpose is to arouse public interest in aerial questions, to stimulate study and research, and to help the development of "British Imperial Aeronautics," without adhesion to any clique or party. It is controlled by a council, with Mr. L. Blin Desbleds as director and hon. secretary, and will appear monthly. The issue contains articles on the Air Board, our pre-war neglect of aerial possibilities, the steel construction of aeroplanes, &c., and details of the membership and constitution of the Aeronautical Institute of Great Britain. We cannot see far into the future; who can say that the Institute may not eventually rival in importance the great engineering institutions of which we are so proud?

"Manual of Electrical Undertakings and Directory." 1916-17. Vol. XX. London: Electrical Press, Ltd. 21s. net.

A.E.G. Electric Co., Ltd.: Sale.—Messrs. Wheatley Kirk, Price & Co., by order of the Controller in this case, are offering for sale the stock of electric motors, instruments, fittings and electrical accessories, in one lot by public tender. An announcement appears in our advertisement pages to-day.

For Sale.—Messrs. P. Huddleston & Co. will sell by auction, on Friday, December 15th, at Hammersmith, a quantity of electrical apparatus. Full particulars are given in our advertisement pages to-day.

LIGHTING AND POWER NOTES.

Accrington.—New Plant.—Ald. Higham (chairman of the Electricity Committee) recently stated that the Electricity Department had now obtained delivery of the new turbo and alternator, and the only things they were waiting for were the pumps; they hoped to be running by the end of the month. If matters turned out as successfully as was anticipated, they were quite certain to have a diminution of the troubles they had had for several months, due to various conditions.

Argentina.—In September last the Pedro Mendoza central power station, Buenos Aires, of the Compania Italo-Argentina de Electricidad, was formally inaugurated, this completing the present system of the company, which was founded in 1911. The work has been carried out with the industrial and financial assistance of Messrs. Franco Tosi, Pirelli, and Brown Boveri, the capital involved being 50 million francs. The steam plant at the main station consists of four batteries, each consisting of two boilers, with economiser, forced-draught plant, and steel chimney. Liquid fuel is principally used, and a large storage is provided, fed by tank wagons of road or railway type. Special turbine pumping plant is installed for the oil fuel. Three 6,000-kw. turbines sets are installed, generating three-phase current at 6,600-7,000 volts, 50 cycles, and each fitted with a direct-driven exciter. A further installation of turbine plant has been contracted for, bringing up the total plant capacity to about 30,000 kw. From the main station, energy is transmitted to five sub-stations, which distribute direct current within a specified central zone of the city; these sub-stations are equipped with the necessary transforming plant, some 10,500 kw. in capacity, and, in addition, with independent Diesel engine generators—13 in all—consisting of 800-h.p. engines driving 500-kw. generators. For a year and a half this Diesel plant has been supplying consumers pending the completion of the main plant. For some time 1,600 public arc lamps have been supplied, also about 1,000 arcs in the port, while 12,000 private installations were also being supplied at the end of September.—*Review of the River Plate.*

Barrow.—The electrical engineer (Mr. H. R. Burnett) has been authorised to assist the Joint Committee in connection with the proposals for interconnection and joint working of electric supply undertakings.

Belfast.—Proposed Extensions.—At the monthly meeting of the Corporation the question of extending the electricity plant was considered. The Committee now proposed to place the matter in the hands of experts, and it was decided to obtain the advice of Sir John Snell as to any modifications being made in his report of August, 1914, on the extension question. During the discussion it transpired that recent applications were very nearly refused—so narrow was the margin—and that with the exception of one other town in the United Kingdom, Belfast had the lowest reserve of plant. It was decided to confirm the proposals of the Electricity and Tramways Committee in view of the seriousness of the situation. The proposed new generating station may cost up to £100,000.

Birmingham.—Price Increase.—The Electric Supply Committee reports that on March 7th, 1916, it increased the charges to consumers supplied with low-tension electric current, by 15 per cent. to lighting consumers and 20 per cent. to power consumers. The Committee has had before it the returns for the first six months of the present financial year, and it is evident that the expenses will be even heavier proportionately during the forthcoming winter. The high-tension consumers, under the Coal Clause in their agreements, automatically pay an increased rate. The low-tension lighting and power consumers pay a fixed rate, and the Committee considers a further increase should be made in these rates. In conclusion, the Committee stated that it had decided that the increase of 15 per cent. to lighting customers previously sanctioned in March be raised to 30 per cent., and that the 20 per cent. increase for power, heating and cooking made in March, be raised to 30 per cent., and that these additional increases take effect from the December reading of the meters; at the City Council meeting on Tuesday an amendment was carried, increasing the price for power, heating, &c., by 40 per cent. on pre-war prices. The Finance Committee has reported having obtained the sanction of the L.G.B. to a loan of £7,530 for additional cooling towers and pipe line in connection with the alteration of the scheme for the extension of the temporary electricity generating staton at Nechells.

Blackpool.—The Finance Committee has agreed to supply electric light for the soldiers' rest clubs and recreation-rooms at a 50 per cent. reduced cost, so long as the consumption does not exceed that of the 1914-15 winter, when concessions of this kind were first granted; any electricity used in excess of this amount will have to be paid for in full.

Bolton.—Linking-up.—At a meeting of the Electricity Committee, consideration was again given to the report on the interconnection of the Lancashire and Cheshire electricity supply systems, and the principles of the scheme were approved.

Christchurch.—The Bournemouth and Poole Electricity Supply Co. has refused the offer of the B. of G. to pay five per cent. increase on the contract price for current from January 1st, and the offer has been withdrawn. The Guardians take the view that they are liable for the contract price only.

Deal and Walmer.—The B. of T. has granted a year's extension to the Gas and Electricity Co. for laying electric distributing mains in the scheduled area.

Dublin.—The Electricity Committee has issued a report protesting against the methods adopted by the Special Committee of Investigation, which, it says, did not consult the former Committee or the officials, did not permit the officials to be present at its meetings, has not made a report as a Committee on any one of the seven heads of its instructions, and has expressed no opinion of its own on any of these points. The Electricity Committee claims to have overcome the very serious difficulties of the present situation, and to have made arrangements which guarantee the maintenance of the supply in the future, and demands that the Special Committee's report be referred to it for investigation, with the same powers as were conferred upon the latter Committee.

At the monthly meeting of the Corporation, this week, it was decided, on the suggestion of Mr. L. Sherlock, ex-chairman of the Electricity Supply Committee, that consideration of the Electricity Special Inquiry Committee's report, Mr. D'Alton's expert report, the Committee's recommendations, the officials' replying reports, and the Supply Committee's report in reply and protest, should stand over pending the summoning of a special meeting.

Year's Working.—The Electricity Supply Committee's statement of accounts for the year ended March 31st last shows that the total income from the sales of electricity, meter rentals, public lighting, and miscellaneous sources was £134,555, and the expenditure £70,134, leaving a balance to be carried to

net revenue account of £64,421. The total capital expenditure at the end of the year was £857,350, an increase of £22,594 on the previous year. The total income for the year was £124,883, as against £105,440 in the previous year; and the working costs were £60,461, as against £50,444. The total surplus to be carried to next account is £16,443. A sum of £337 has been transferred to renewal account. The surplus for the year is given at £8,840, as compared with £1,416 in the previous year. The total units sold increased from 9,519,545 in 1915 to 10,338,558. The cost per unit sold increased from 2·26d. to 2·69d. Against this is the fact that the average price obtained increased from 2·56d. to 2·80d. The total maximum supply demanded during the year was 7,288 KW., against 7,486 KW. in 1915. The capacity of the dynamos at the end of the year was 12,000 KW.

The Committee announced that owing to the new restrictions on the purchase of electrical material, it was not in a position just now to deal with applications for new supplies to ordinary consumers.

Dundalk.—PROPOSED LOAN.—The Urban Council is applying to the L.G.B. for a loan of £5,000 to enable it to carry out such improvements as will allow the Diesel engines in the electric lighting department to consume tar oil instead of petroleum fuel.

Eccles.—PRICE INCREASE.—The Electricity Supply Committee has decided to further increase the charges for electricity from January 1st as follows:—Private and public lighting, 15 per cent. to each account, making 25 per cent. in all; general power, heating and cooking, 5 per cent. to each account, making 25 per cent. in all.

Edinburgh.—The Electric Lighting Committee has decided not to insist on the payment of the minimum charge of 10s. by consumers who are on active service. The Committee agreed that before any action was taken in regard to arrears, the circumstances should be reported to the convener.

Ennis (Co. Clare).—E.L. SCHEME.—A public electric lighting scheme has been suggested, and it is thought probable that steps will soon be taken in the matter.

Faversham.—The T.C. has decided not to increase the price of current at present.

Finchley.—A resolution from the East Finchley Ratepayers' Association upon the subject of electricity charges has been referred to the Electricity Committee; the Association desires the abolition of the minimum electric light charge, and that the 20 per cent. addition recently made be only upon units consumed. An equitable flat rate, power rate, and street lighting rate, the increase and decrease of each to be governed by the conditions prevailing from time to time, are asked for.

Grantown.—PRICE INCREASE.—There was considerable discussion at a meeting of the T.C. on the explanation by Mr. Anderson, electric light contractor, of his action in raising the price of electricity to private consumers by a 1d. per unit. The Council ultimately agreed to recommend private consumers to pay the extra charge.

Halifax.—The Electrical Distribution of Yorkshire, Ltd., having decided to apply for powers to supply electricity within the area of the Luddenden Foot U.D.C., the Tramways and Electricity Committee has empowered the Electricity Sub-Committee to take steps to safeguard the interests of the Corporation. A Sub-Committee has been appointed to confer with the Gas Committee on the question of joint central offices, showrooms, &c., for gas and electricity purposes.

Harrow.—STREET LIGHTING.—Through the discontinuance of street lighting, the U.D.C. has saved £520 during the past six months.

Hornsey.—The T.C. has been asked by the Hackney B.C. to contribute towards the cost of defending an action brought by the Gas Light and Coke Co. in respect of a reduced charge made for electrical energy supplied for lighting purposes to customers who are power consumers, it being alleged that the charge constituted an undue preference. The communication was referred to the Electricity Supply and Finance Committees.

Kendal.—The manager of the electricity undertaking has been instructed to procure samples of electrical heating apparatus for advertisement. The charge for electricity for power purposes to consumers of 8,000 units per annum and upwards has been fixed at a flat rate of 1½d. per unit.

Leyton.—For the destructor works a 30 to 40-H.P. motor is to be purchased, at a cost of from £100 to £120, to drive the air-compressor by electricity when steam is low, instead of burning coal.

London.—WOOLWICH.—PLANT EXTENSIONS.—Details of a further extension of turbine plant and mains, estimated to cost £21,000, have been approved, and sanction is to be asked for the borrowing of the money. In regard to a former loan of £27,500, it has been agreed to repay this on the instalment system instead of the annuity system. Application is to be made for sanction to a loan of £2,442 for mains extensions, and 55 street lamps are to be fitted with automatic switches, thus economising in labour.

HACKNEY.—The accounts of the Council's electricity undertaking for the year ended March 31st last show a deficit of £7,605. Owing to increased price and poor quality of fuel, the cost of production increased by £6,022, loan charges also increased by £4,165, and allowances to employés on active service amounted to £1,986. Owing to the lighting restrictions, the revenue from private lighting dropped £3,878, in addition to £546 from public lighting; the revenue from power showed an increase of £3,739. The sales department made a profit of £772, as compared with £120 in the previous year. The balance standing to reserve amounts to £23,981, after making allowance for last year's deficit.

Plymouth.—QUARTER'S WORKING.—The engineer's report of the working of the electricity undertaking for the quarter ended September 30th showed a consumption of 1,302,587 units, producing £10,785, as compared with 1,305,317 units sold and £11,403 in the corresponding period of last year. Added to the income of the June quarter the total amounted to £22,459, as against £22,779 for the corresponding six months of 1915.

Salford.—LINKING-UP.—The Electricity Committee approves in principle the scheme outlined in the interim report of the Committee for the interconnection of Lancashire and Cheshire Electricity Supply Systems. Five representatives of the Electricity Committee have been appointed to attend a conference of electricity supply authorities to be convened to consider the matter.

Sevenoaks.—The U.D.C. has given consent to the Electricity Co. to place outside cables for the supply of current to houses in Mount Harry Road.

Sunderland.—PLANT EXTENSIONS.—At the annual meeting of the Corporation Electricity and Lighting Committee on Friday last, the chairman said they had passed through a busy year, during which they had added to their list of consumers a number of works and a steel furnace. Permission had been given for the purchase of a new turbine for the Hylton Road extensions, which were estimated to cost £45,000, and the L.G.B. had authorised the borrowing of the money. Tenders were now being advertised for.

Woking.—FIRE.—Damage estimated at about £1,000 was done by a fire which occurred on the premises of the Electric Supply Co. at midnight on Sunday. It is believed that the fire originated in the overheating of some stored slack. The damage largely represents burnt cable, which was insured.

Wrexham.—PRICE INCREASE.—The charges for energy have been advanced by 10 per cent., as from January 1st, by the T.C.

York.—LINKING-UP.—Reporting on this question to the Electricity and Tramways Committee, Mr. J. W. Hame, the city electrical engineer, stated that York was so far from Leeds, Hull, or Harrogate, where supply stations of importance were situated, that the cost of labour involved in carrying out a linking-up scheme would make interconnection impracticable at the present time. The Yorkshire Power Co. was supplying its Selby area, but there would be no advantage in connecting up there yet. The policy they were adopting was to centralise the power production in the city and district.

TRAMWAY and RAILWAY NOTES.

Abingdon.—According to the *Surveyor*, as a result of the action brought by the R.D.C. against the Oxford Tramways Co., the latter has at once changed the route of its 'buses in the Abingdon district, which now run on the main roads under the care of the Oxford County Council.

Blackburn.—THROUGH RUNNING.—As a result of the discussion with the Accrington Corporation Electricity and Tramways Committee on the question of future through running, the two Corporations have decided to enter into an agreement for the future on the basis of an equal car-mileage being run by each Corporation's cars over the other Corporation's lines. The agreement comes into force on January 1st.

Blackpool.—The T.C. has agreed to a recommendation from the Tramways Sub-Committee that the last cars should leave the town centre not later than 10.30 p.m. The aggregate revenue for the year to date on the Blackpool-Fleetwood cars is £42,715, compared with £37,809 a year ago.

Bolton.—The Tramways Committee has decided not to accede to an application by the Amalgamated Association of Tramway Workers for alterations and increases in the wages of various classes of tramway workers.

Burnley.—The Tramways Committee has decided not to entertain the suggestion of the Amalgamated Association of Tramway and Vehicle Workers that tramway traffic should be suspended on Christmas Day, and the wages paid to the employés for the day.

Ilford.—CABLE BREAKDOWN.—The tramway manager reported that on October 21st feeder cable No. 4 broke down. It was laid in 1912, nearly four years ago, being supplied by the Standard Cable Co., an entirely German firm. As the cable had to be replaced immediately, a tender was accepted from Messrs. Henley, at £138 for 440 yards of cable, to be delivered within 10 days.

Keighley.—A statement issued to the Corporation last week shows that the tramway receipts from April 1st to November 23rd gave an increase of £445, but there was a decrease on the railless trolley vehicles of £378.

Women tramcar drivers are now in training in the town, and have appeared on the streets in company with a male supervisor. The Keighley routes are amongst the easiest to be found anywhere in the country.

Leyton.—Wages.—Increases of wages are to be made to the employés of the tramway department, at an estimated net cost of £1,100 per year. The tramway manager reported difficulty in purchase of rails and tires; the matter has been referred to the Committee's chairman and the tramway manager to deal with.

London.—In a brief *résumé* of electric railway work round London, the *Railway Gazette* mentions that the Central London extension to Ealing is well under way, though the Gunnersbury extension is held up. Experimental runs have been made with Bakerloo tube trains on the Watford section of the North-Western line, in connection with the future through service; the difficulty to be met is the question of platform height, owing to the tube train floors being considerably lower than the normal railway coach floors.

Land has been purchased for the Hampstead Railway extension to Hendon, and on the City and South London Tube an experimental section of the larger normal diameter has been inserted. This tube is to be extended from Euston to Camden Town, where a junction will be made with the Hampstead and Highgate Tube Railways.

Amongst the lines held up by the war are the Wimbledon and Sutton Railway, the Piccadilly Railway extension to Gunnersbury and Richmond, in connection with which a new station is to be built beneath Hammersmith Broadway, while the further scheme for providing a deep level line below the District Railway to relieve rush traffic is stated to have not been abandoned altogether.

L.C.C.—The *Surveyor* draws attention to the excellent manner in which the Council's tramway service was maintained during a recent dense fog, adding that it certainly appears that the tramcars scored on this occasion at any rate, not in spite of, but because of, the necessity for their travelling along a fixed line of rails.

Woolwich.—The doubling of the tramway track in Plumstead Road has been urged on the B.C., and it has been suggested that the L.C.C. should carry out the work as a temporary measure, but apparently the local Council refuses consent to the work being done unless certain road widening is also done at the same time.

Manchester.—The Workmen's Special Committee of the Council reported that, having regard to the privileges the Corporation grant to its employés as regards holidays and otherwise, it cannot recommend the Tramways Committee to comply with the application of the Electrical Trades' Union for treble pay in respect of Christmas Day and Good Friday for electricians and wiremen in its employ who work on those days.

Mexico.—According to the *Mexican Review*, a novel feature of the excellent electric car system of Mexico City and its suburbs is the provision made for carrying freight of all kinds, including live animals, on the same cars with passengers. Each train is made up of two large cars—the one in front being for first-class passengers and the one in the rear for second-class, the fare in the first being exactly double that in the latter. One end of the second-class car is partitioned off for freight, and here one can see chickens, goats, turkeys, pigs, calves and other live stock, vegetables, flowers, fruit, wood, and all manner of rural products, all of which are conveyed to the heart of the city from distances of 5 to 10 miles and more in the country. This is a very profitable portion of the company's business.

The electric car lines of Mexico City have been placed in first-class order again, having been seriously crippled during the Zapatista occupation in the early part of 1915, and it having been difficult to secure the necessary machinery and supplies owing to the situation in Europe. This has been remedied, however, and now the service is being re-established upon the former very efficient basis. Prior to the revolution the local transportation system of Mexico City and its suburbs was noted as one of the best and most extensive in the world.

Nelson.—Arrangements have been made between the Nelson and Colne Corporations for a curtailed tramway service. During the winter months it has been decided to discontinue the last hour service, except on Saturdays.

Rossendale.—Arbitration.—The inquiry regarding the rearrangement of fares and stages, as between the Rawtenstall and Bacup authorities, which has been conducted by Mr. J. M. McElroy, of Manchester, on behalf of the B. of T., was concluded last week.

Salford.—Electric Vehicle.—The Electricity Committee has ordered an "Orwell" tipping wagon, at a cost of £795, the amount to be taken from the renewals fund.

Stockton.—Proposed Tramway Purchase.—With regard to the proposed purchase of the tramway system in the borough, a letter has been received by the T.C. from the Middlesbrough Corporation, stating that that body had appointed a Committee to consider the question of the purchase of its local tramway system, and suggesting a conference between the two authorities, together with a representative from Thornaby. The Stockton T.C. has appointed a deputation accordingly to meet the Middlesbrough Committee.

Walsall.—The Corporation Tramways Committee recently decided to run a restricted service on Christmas Day; the employés have been agitating for the discontinuance of the service on that day, and threaten not to operate the cars.

TELEGRAPH and TELEPHONE NOTES.

France.—The telegraph and telephone tariffs have been raised by levying a tax of 2½d. per telegram up to 50 words, in addition to the normal charge of ½d. a word, and increasing the annual payment for a private telephone from £16 to £20.

India.—Between April, 1912, and March, 1915, the telegraphic network of British India increased by 12,833 km. of line and 56,183 km. of wire, the totals being 135,489 and 531,353 km. respectively. The number of offices open to public service increased by 7,710 to 8,438, and the number of telegrams handled from 13·84 to 14·92 millions (internal), but the international traffic, which rose to 1·66 millions in 1913-14, fell to 1·27 millions in 1914-15. The revenue from the telegraphic service rose from 17·68 million francs in 1912-13 to 20·79 millions in 1914-15. The number of telephone exchanges at the end of 1914 was 186, with 15,476 connections.—*Journal Télégraphique.*

Mauretania.—Two wireless stations have been opened at Atar and Chinguetti, in communication with the station at Port Etienne.—*Journal Télégraphique.*

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—January 22nd. Electrical plant (converter, battery, booster, and switchboards) for the Castlereagh Street sub-station, for the Municipal Council. Specification from E.L. Department, Town Hall.*

Queensland.—December 12th. P.M.G.'s Department. Caps and lamps for switchboard, covered wire, benders, sleeves, and tapes. See "Official Notices" December 1st.

January 1st. P.M.G.'s Department. Cords, switchboard, parts and accessories, measuring instruments and telegraph instruments. See "Official Notices" December 1st.

Aylesbury.—December 16th. U.D.C. Electricity Department. Paraffin oil for one year (800 gallons); Diesel lubricating oil for one year (500 gallons). See "Official Notices" to-day.

Bridgend.—December 15th. Hospital Committee. Electrical wiring at the Isolation Hospital, Cefn Hirgoed. Mr. D. R. Jones, Clerk, 10, Wyndham Street.

Cape Town.—January 5th. Electric motors and starting panels, for the Corporation Electricity Department. Dock Road. Cape Town.*

Durban.—January 3rd. Corporation. One 3,000-kw. steam turbine, alternator, and condensing plant. Specification No. S. 238; drawing No. P. 597, both at the office of the Borough Electrical Engineer, Municipal Buildings. Deposit £2 2s.

Johannesburg.—December 20th. Corporation. Automatic pressure regulators for the A.C. turbo-generators at the power station.*

January 3rd. Corporation. Iron axles and bushes.*

London.—Enfield.—Electric light installation, Ponder's End Congregational Church. Rev. J. H. Bennett, pastor.

December 16th. H.M. Office of Works. Materials for electric bell wiring. See "Official Notices" to-day.

L.C.C.—December 19th. 325 tons of rolled-steel bars for magnetic brake shoes. Chief Officer, L.C.C. Tramways, 62, Finsbury Pavement.

New Zealand.—Dunedin.—January 24th. Motor-generator, accessories and spares. City Electrical Engineer, Market Street, Dunedin.*

Tauranga.—February 12th. Borough Council. Supply of six three-phase transformers, 11,000-400 volts. Messrs. H. W. Clime and Sons, Consulting Engineers, Raetihi.—*N.Z. Shipping and Commerce.*

Salford.—December 13th. Two electric passenger lifts (push-button system) at Union Infirmary, Hope, Pendleton, for the Salford B. of G. Specifications, &c., from Mr. E. H. Inchley, Clerk to B. of G., Poor Law Offices, Eccles New Road.

Spain.—The municipal authorities of Soria, in the province of that name, have lately invited tenders for the concession for the electric lighting of the town during a period of four years. The electric lighting contract for the town of Alcoy (Province of Alicante) has also lately been up for tender; no period was, however, in this case mentioned,

Sunderland.—December 9th. Steam turbine, alternator, and condensing plant, at Hylton Road electricity works. Specifications and forms of tender (£3 3s.) from Mr. A. S. Blackman, General Manager, Electricity Offices, Dunning Street.

Warrington.—December 12th. Electricity and Tramways Committee. Twelve months' supply of earthenware conduit. See "Official Notices" December 1st.

December 12th. 7,000 tons of slack coal for the electricity works, Howley. Specifications (£1 1s.) from Mr. F. V. L. Mathias, Borough Electrical and Tramways Engineer.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Department in London.

CLOSED.

Blackpool.—Motor-generator for testing purposes, for the Electricity Department: Electric & Ordnance Accessories Co., Ltd.

Luton.—T.C. Electricity Department. Accepted tenders:

British Vacuum Cleaner Co.—Flue-cleaning suction plant, £280.

J. Facer & Son.—5,400 tons of South Leicester slack coal, at 17s. 5d. per ton (16s. 5d. in Corporation wagons) during the winter months, and 17s. 11d. (16s. 11d. in Corporation wagons) during the summer months (same prices as in the previous year).

Newbold & Martell.—7,000 tons of Whitwick Deep nutty slack coal, at 18s. 9d. per ton (17s. 3d. in Corporation wagons) (same prices as in the previous year).

J. Facer & Son.—6,000 tons of Hucknall Main bright slack, at 17s. 11d. per ton (16s. 11d. in Corporation wagons) (same prices as in current year).

W. H. Bowater, Ltd.—6,000 tons of Ibstock D.S. nuts, at 20s. 7½d. per ton (19s. 1½d. in Corporation wagons), and 2,000 tons of peas, at 19s. 1½d. per ton (17s. 7½d. in Corporation wagons). Messrs. Bowater's tender showed an increase on the nuts of 1½d. on the current year's prices, and on the peas of 7½d. on the 19s. 1½d. per ton, and 1½d. on the 17s. 7½d.

Manchester.—Electricity Committee:—

Low-pressure pipes and supports.—Aiton & Co., Ltd.
Lea recorder.—Lea Recorder Co., Ltd.
High and low-pressure pipework.—Stewarts & Lloyds, Ltd.
Valves.—Blakeborough & Sons.
Cables.—Pirelli-General Cable Co.; Western Electric Co.; B.I. & Helsby Cables, Ltd.; W. T. Glover & Co., Ltd.

Reigate. B. of G. Electric cable for the laundry at £175, and for a motor at £20: Tamplin & Makovski.

Salford.—Tramways Committee:—

Installation of electric light, &c., at the Permanent-way Depôt, Broughton, £100 10s.—J. Lomax, Kendal & Co.

Electricity Committee:—

Various lengths steam piping at the electricity station.—Newall's Installation Co.
Orwell tipping wagon, £795.—Mossay & Co., Ltd.

Woolwich.—B.C. Accepted tender:—Rees Roturbo Manufacturing Co., Ltd., 6,000-gal. pump for cleaning the boilers at Globe Lane Works, £73 10s.

FORTHCOMING EVENTS.

Junior Institution of Engineers.—Friday, December 8th. At 8 p.m. Paper on "Paraffin and the Internal-Combustion Motor," by Mr. S. C. Sanders.

Saturday, December 9th. At 2.30 p.m. Visit of inspection of the mechanical plant for lighting, ventilating, cooking, and heating services at the Holborn Restaurant, Kingsway, W.C.

Monday, December 11th. At 8 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Presidential address, "Industrial Engineering: Present Position and Post-War Outlook," by Mr. F. W. Lanchester.

Chief Technical Assistants' Association.—Saturday, December 9th. At 3 p.m. At the Tavistock Hotel, Covent Garden. Discussion on "Coal and Ash-Handling Plant."

Society of Engineers.—Monday, December 11th. At 8 p.m. At Burlington House, Piccadilly. Papers on "The Sources of the Minerals required by the Iron and Steel Industries of the U.K.," by Prof. W. G. Fearnsides; "The Mineral Resources of the British Empire as regards the Production of Non-ferrous Industrial Metals," by Prof. C. Gilbert Cullis.

Royal Society of Arts.—Monday, December 11th. At 5 p.m. At John Street, Adelphi. Howard Lecture, "Coal and its Economic Utilisation," by Prof. J. S. S. Brame.

Wednesday, December 13th. At 4.30 p.m. At John Street, Adelphi. Paper on "The Development of Imperial Resources," by Mr. H. Wilson Fox.

Association of Supervising Electricians.—Tuesday, December 12th. At 7.15 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Electric Meters," by Mr. J. Rennie.

Liverpool Engineering Society.—Wednesday, December 13th. At the Royal Institution, Colquitt Street. Paper on "Works Costing Systems," by Mr. H. Shephard.

Association of Engineers-in-Charge.—Wednesday, December 13th. At 8 p.m. At St. Bride's Institute, Bride Lane, E.C. Paper on "Solid Fuels," by Mr. S. G. Martlew.

Institution of Electrical Engineers.—Thursday, December 14th. At 8 p.m. At Victoria Embankment. Paper on "Colonial Telegraphs and Telephones," by Mr. R. W. Weightman.

(**Western Local Section**).—Monday, December 11th. At 5 p.m. At the South Wales Institute of Engineers, Park Place, Cardiff. Kelvin Lecture, "Some Aspects of Lord Kelvin's Life and Work," by Dr. Russell.

(**Manchester Local Section**).—Tuesday, December 12th. At 7.30 p.m. At the Engineers' Club. Illustrated lecture, "Some Aspects of Industrial Research, with special reference to American Research Activities," by Mr. A. P. M. Fleming.

(**Scottish Local Section**).—Tuesday, December 12th. At 7.30 p.m. At 207, Bath Street, Glasgow. Paper on "The Parallel Operation of Electrical Power Stations," by Mr. J. S. Peck.

Greenock Electrical Society.—Thursday, December 14th. At 7.45 p.m. At 22, West Stewart Street. Paper on "The Art of Wiring," by Mr. J. Nichol.

Institution of Mechanical Engineers.—Friday, December 15th. At 6 p.m. At the Institution of Civil Engineers, Great George Street, Westminster, S.W. Paper on "Variable-speed Gears for Motor Road Vehicles," by Mr. R. E. Phillips.

Illuminating Engineering Society.—Friday, December 15th. At 5 p.m. At the Royal Society of Arts, John Street, Adelphi, W.C. "Suggestions regarding War Economies in Lighting," by Mr. L. Gaster.

Association of Mining Electrical Engineers (West of Scotland Branch).—Saturday, December 16th. At 4.30 p.m. At the Royal Technical College, Glasgow. Social evening.

NOTES.

The Motor-Ship "Glenamoy."—This ship, recently completed by Messrs. Harland & Wolff, is equipped with two six-cylinder Burmeister & Wain Diesel engines, giving a total of 3,600 H.P.; a large electrical plant is provided, all the auxiliaries being electrically operated, and including 19 electrical winches of 7 or 4 tons capacity, electric steering gear and electric cooking.

United Kingdom Manufacturers Represented in U.S.A.—H.M. Consul-General in New York (Mr. C. Clive Bayley) requests United Kingdom manufacturers who have branches, agents or other representatives in the United States to forward to him the addresses of such representatives, as these will be of great assistance to him in dealing with the frequent inquiries he receives from American merchants.—*Board of Trade Journal.*

Essay Competition.—The Dorset Field Club is offering the "Cecil" Medal and prize of £10, to be awarded next May, for the best paper on "The More Recent Applications of Electricity in the Present War; Especially in the Treatment of Diseases and Wounds Arising Therefrom." An announcement appears in our advertisement pages to-day.

The "Dacia" Torpedoed.—A Press dispatch from Lisbon states that the British ship *Dacia* has been torpedoed and sunk. Her tonnage was 1,473 net and 1,856 gross. She was built in 1868, and was owned by the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd. German submarines have raided Funchal, Madeira, their bombardment being specially directed against the English submarine cable station.

Central Station Men and Military Service.—At a meeting of the Heston and Isleworth U.D.C., on Tuesday evening, Mr. Palmer said that one of the local Tribunals had publicly attacked the Council's electricity department for refusing to release some of its men of military age and fitness. The Electricity Committee had tried hard to get men to replace them, without success, at which he did not wonder, seeing how valuable the services of electricians were just now.

Mr. Bonnett said they had 13 men fit for the Army, and the Council ought to release them. The engineer got them badged, but he did not know that the Council had ever sanctioned such a proceeding. The Council was being attacked on all sides for keeping its employés from doing their duty to the country, and it was nothing but a scandal.

Mr. Heath said that he was astounded to hear there were so many men still retained, for he had always been fighting to get them into the Army. The engineer had never received sanction to keep the men out of the Army. They were all married, and their ages were from 25 to 39, and it was quite possible to substitute them by women. They knew that women were attending to switchboards and doing lots of duties that men used to do. He would move that the names of the men be sent to the Ministry of Munitions and the military representative, who would soon see which of the men could be retained.

Lieut. Chapman pointed out that meter reading and switchboard work could be done by women. As the street lamps were out, there was no need for a public lighting attendant.

Mr. Meyers, chairman of the Committee, assured the Council that the engineer had done all in his power to find substitutes for the men. They were willing to go, but there must be others to take their places. The Council could not get the roadmen or scavengers to do their work, which was technical, and required a great deal of knowledge. The engineer had to keep the works going to meet contracts and supply the public demands; but if the Council would exonerate him from blame, he would dislodge the men the very next day. The engines were running day and night, and the men worked in three shifts of four each, and though members had boasted they could save four of these men, never a one of them had shown how it could be done. They must have technical men to send out at any moment to see to faults or to attend to sudden calls, and in a district where there was much work depending on both the day and night load, the staff must be kept up.

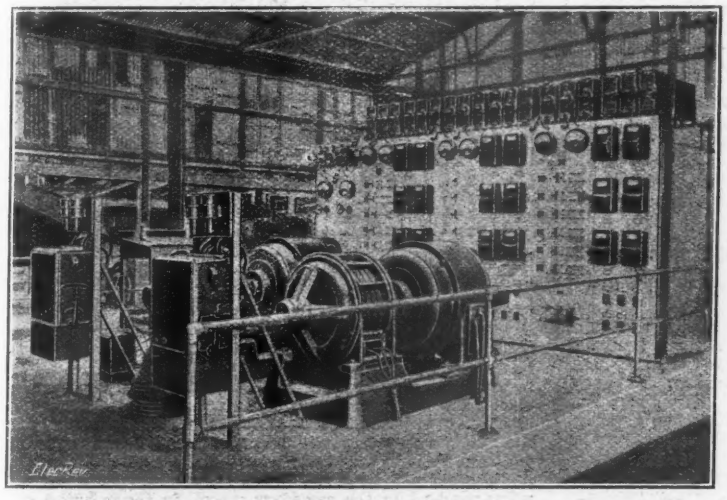
The discussion then dropped.

The Local Government Board has forwarded to municipalities throughout the country a memorandum prepared by the Home Office and Board of Trade dealing with the substitution of women for men in municipal services, particularly in electricity undertakings.

It is stated that at the request of the military authorities the Ministry of Munitions has reviewed the certificates held in connection with war-service badges by employés at the Bath Electric Light Works, and as a result has disbadged three men.

American Capital in Norway.—American capital is employed in building a factory for the production of calcium carbide at Saude in the district of Stavanger, where there are falls suitable for the generation of large amounts of electrical power. Other electrochemical products are to be turned out by this factory, for shipment to New York and sale in the American market. First shipments should be ready early in 1918, as the contract calls for the finishing of the plant by January 1st of that year. The new company is registered in Canada, and is called the Electric Furnace Products Co., Ltd. Edgar F. Price, an officer of the Union Carbide Co., of New York, is president of the organisation. The power for the factory is to be supplied by the Saude Falls Co., a Norwegian corporation financed by Norwegian capital. A lease of 40 to 50 years for the use of the power has been taken from this corporation by the Canadian Co., and the Norwegian corporation already has more than 250 men at work. There are three sources for the power now to be used, each of which will come from a 1,000-ft. head. In all they will generate a total of 40,000 H.P. Later the tail water will be carried in a tunnel nearly 5 miles through the mountains to a place where it will fall into the salt water of the fjord. This will generate another 40,000 or 45,000 H.P. Although this end of the fjord is about 70 miles from the sea, the water is so deep that large ocean steamers can come direct to the company's docks and take the goods for shipment to the United States. The Saude plant will be one of the largest in Norway.—*Electrical World.*

Vehicle Charging in Sydney, N.S.W.—The number of electric vehicles in Australia at the present time is not very large, but continual progress is being made. In Sydney a garage has been established by the City Council at Palmer Street, and the charging station (our view of which is reproduced from the *Commonwealth Engineer*) is the first of its kind in Australia. The plant consists of two motor-generator sets together with a charging switchboard. Included in the vehicles that are regularly charged and maintained at the station are two 5-ton, two 2-ton, two 30-cwt., two 15-cwt.



VEHICLE BATTERY-CHARGING STATION OF THE SYDNEY COUNCIL, N.S.W.

one 1-ton, one 10-cwt., and ten electric broughams; a number of others are also on order. The brougham and runabout are stated to to be popular in Sydney; and an exceedingly light runabout has recently been introduced—the Milburn light vehicle, which has travelled a distance of 70 miles on one charge. The City Council's charging station possesses all the necessary facilities for the care and maintenance of electric vehicles.

Carbon Electrodes in Germany.—One of the results of war conditions in Germany has been the standardisation of carbons for electric furnaces. According to the new rules, round carbons for steel furnaces are to be made in sizes varying in thickness from 100 mm. upwards, by steps of 25 mm., to 250 mm. diameter and by steps of 50 mm. for larger sizes, the tolerance varying from 3 mm. to 6 mm., according to size. For rectangular electrodes used with other kinds of furnaces the standard size has been fixed at 500 mm. square. The standard length may ultimately be raised to 2·4 m., but for the time being is fixed at 2 m. All lengths, however, may be varied in multiples of 20 mm., and the tolerance is to be 20 mm. A table has been published giving the standard dimensions to be adopted for upper holders with cylindrical threads screwed into the carbons.—*Iron and Coal Trades Review.*

Hydro-Electric Works in France.—During the past 20 years many efforts have been made in the French Chamber of Deputies with the object of securing the passage of a Legislative measure which would ensure the methodical utilisation of the hydraulic forces of the country in connection with the production of electricity. All these schemes, however, have failed to mature, chiefly in consequence of the difficulty of finding a just interpretation of the right of granting concessions by the State. When the question concerned waterways under the control of the Government no disagreement arose, but when the interests of private owners were affected the harmony suddenly disappeared. The war, however, has demonstrated the necessity for utilising to a much greater extent the extensive water powers with which the country has been richly endowed by nature. Just as the French cannot possess too many guns and too much ammunition for the successful prosecution of the war, so can they not have too many water powers in use for the production of electrical energy, because the country is poor in coal resources as compared with its industrial progress. Prior to the war France was compelled to import 20,000,000 tons of coal and coke per annum, and when peace is restored, and even if the German coal basin of the Saar, with its annual output of 15,000,000 tons of coal should be annexed, it is considered that the industrial expansion would still render it essential for the French to obtain from 10,000,000 tons to 15,000,000 tons of coal per year from abroad, unless the existing water powers are drawn upon in a considerably greater measure than is the case at present.

According to a report prepared a few years ago by M. Pinot, general secretary of the Comité des Forces Hydro-Electriques, the water powers capable of being utilised in France represent 5,850,000 H.P. This power compares with 7,500,000 H.P. in the case of Norway, 6,750,000 H.P. in Sweden, 6,460,000 H.P. in Austria-Hungary, 5,500,000 H.P. in Italy, 1,500.000 H.P. each in Spain and Switzerland, 1,425,000 H.P. in Germany, and about 1,000,000 H.P. in England. Yet, with such considerable resources at disposal, it was shown by M. Ader that only 10 per cent. had been brought into useful service by 1911. Since that time good progress has been made, particularly during the course of the present war, and further works are still being carried out. It is estimated that a total of £60,000,000 has been invested in hydro-electric works throughout the country. Nevertheless, it is believed that falls representing a further 1,500,000 H.P. could be profitably used, and that the State should intervene and render assistance in the development of the resources.

A Bill has now been introduced in the French Chamber by four private members, with the object of attempting to reach a solution of the problem. The Bill proposes a form of nationalisation of electrical energy in the sense that the right of granting concessions should be vested in the State. The undertakings are classified as works of 500 KW. which do not sell energy, and works of from 500 KW. to 10,000 KW. The former would be subject to State sanction, and powers in regard to waterways not owned by the State would be granted for a period of 50 years, and be capable of extension for a similar term. In the case of large works the concessions would only be given to limited companies after inquiry by the Minister of Public Works, in conjunction with the Ministries of Agriculture and Home Affairs, and provision is made whereby concessionaires would be able to overcome obstacles improperly placed in the way of their undertaking. It is suggested that the State should participate in the profits realised by the first-mentioned class of works without intervening in the management; whilst two representatives of the State would be appointed to the administrative council of the large works. The Bill further exempts existing works, having no title previous to the edict of 1566, from the proposed law for a period of 75 years, and until then no extensions would be possible without authority or submission to the law. The owners of those works possessing the title in question would not be liable to the law unless their undertakings were redeemed by the State: but they would have to pay a tax in order to establish equilibrium with the other works. Excepting the latter class, all the works would revert to the State on the expiration of the concessions, which could be expropriated by the State after the ordinary period of 30 years. It is finally suggested that a Government Committee for hydraulic powers should be created, and formed of officials for one-half of the members, and of representatives of the electrical manufacturing, electrochemical and electrometallurgical industries, and of agriculture for the other half, to work in conjunction with the Ministry for Public Works.

Leeds Engineers' Wages.—An award made by the Committee on Production in connection with an application for an advance of wages made by the Leeds and District Engineering and Allied Trades Joint Committee to the Leeds and District Employers' Association, provides for the time rates of the men concerned, other than the ironfounders, being advanced 3s. a week. The advances are to be regarded as war wages, and recognised as due to and dependent on the existence of the abnormal conditions now prevailing in consequence of the war.—*Leeds Mercury.*

Aluminium as War Material.—The Ministry of Munitions has issued an Order including various classes of aluminium and alloys of aluminium as war material, and cancelling the previous Order dated July 21st last. The classes and descriptions are as follows:—Aluminium and alloys of aluminium, unwrought and partly wrought, including ingots, notched bars, slabs, billets, bars, rods, tubes, wire, strand, cable, plates, sheets, circles, strip; aluminium scrap and swarf, aluminium alloy scrap and swarf, remelted aluminium scrap and remelted aluminium alloy scrap and swarf; granulated aluminium, aluminium powder, "bronze," "flake," and "flitter."—*Morning Post.*

A Birmingham Engineering Federation.—A federation has been formed in Birmingham of all the craft Unions engaged in the engineering industry in the local area. The federation represents over 30,000 skilled workmen.—*Daily Telegraph.*

Institution and Lecture Notes.—University College, London.—In the last of his course of lectures on "Long-Distance Telephony," Prof. Fleming discussed the subject of radio-telephony. After briefly explaining the main principles of wireless telegraphy, he explained the necessity for using a system of continuous undamped waves for telephony, and described various methods of obtaining such waves. The first of these was the high-frequency inductor alternator of Alexanderson, which, by means of high speed of revolution and a large number of poles, produced alternating currents of the necessary frequency—up to 100,000 cycles per second; this machine was made to generate 50 or 100 KW., but was very costly. In the Goldschmidt frequency-raising machine high-frequency oscillations were produced by internal electromagnetic reactions, the unwanted frequencies being filtered out with resonant circuits, and the antenna being tuned to accord with the highest frequency attained. Machines such as these were unsuitable for use on board ship, owing to gyrostatic action and to the excessive wave-length. The Poulsen arc high-frequency generator, with copper-carbon electrodes in a non-oxidising atmosphere, and a simpler arc generator devised by the lecturer, using copper-carbon electrodes in chambers sealed with oil, the vapour of which takes the place of hydrogen, were described, and an interesting experiment with a long helix, showing the production of stationary waves, and proving that the discharges were intermittent, was performed. In Dr. Fleming's opinion, however, although the arc generator is generally used by experimenters, it is not sufficiently developed for practical use; the more he worked with it the less he liked it.

The problem of impressing the voice waves on the antenna current was next discussed, the chief difficulty being shown to reside in the limitations of the carbon microphone transmitter, which can carry only a small current. With a liquid microphone Prof. Vanni had succeeded in telephoning a distance of 600 miles. The Alexanderson magnetic amplifier, in which the saturation of iron was utilised to magnify the microphone effect, was described, and, in Dr. Fleming's opinion, showed much promise. The instrument used in most of the successful experiments, however, was a modification of his own oscillation valve, which he first studied in 1889, and which, he observed in 1904, could be used as a rectifier of alternating currents. By a recent legal decision in the United States this device had been held to contain the essential features of later oscillation valves, and it could be used not only as a receiving valve, but also as a generator of continuous undamped oscillations on either a small or a large scale. Finally, the principle of the Brown telephone relays was explained, with illustrations.

Institution of Mechanical Engineers.—The report of a Committee appointed in 1914 on hardness tests for hardened journals and pins has just been issued; it deals mainly with a series of experiments made at the National Physical Laboratory by Dr. T. E. Stanton and Mr. R. G. Batson with machines arranged to produce wear of the surface under rolling and sliding abrasion. The tests showed that for a given material the resistance to rolling abrasion was roughly proportional to the Brinell ball hardness number. With sliding abrasion, however, it was found that the Brinell hardness numbers of a miscellaneous selection of steels were not a safe guide in predicting their relative resistances to wear.

Diesel Engine Users' Association.—At the November meeting of the Association several new members were elected, and a long list of consulting engineers, manufacturing firms, and others interested in Diesel-engine work, but not qualified for full membership, were accepted as "Subscribers" to the Association. The new class of "Subscribers" are entitled to receive copies of the reports of *Proceedings* and other information and particulars circulated by the Association.

The president (Mr. Geoffrey Porter) announced that the Committee's report on "Air Compressor Explosions and Troubles," with recommendations on the subject, had been finally revised, and that it would be printed and circulated to the members and subscribers.

The hon. secretary gave particulars concerning several types of distance thermometers for use on air compressors, which he had collected from instrument makers, with information concerning cost of installation, &c.

Mr. George B. Vickers read a paper on "Piston and Small-End Lubrication in Diesel Engines," of which an abstract appears elsewhere in this issue.

Royal Society of Arts.—The Juvenile Lectures will be delivered by Mr. A. A. Campbell Swinton, F.R.S., on "Electricity and Its Applications." The lectures, which will be fully illustrated with experiments, will be given on Wednesdays, January 3rd and 10th, at 3 p.m.

Bradford Engineering Society.—At a meeting of the Society last week, Mr. W. Howard Brown lectured on "The Principles of Continuous-Current Motor Starters."

Royal Institution.—The illustrated Christmas course of Juvenile Lectures will be delivered this year by Prof. Arthur Keith, M.D., F.R.S., his title being "The Human Machine which All Must Work." The subjects are as follows:—"Living Engines," December 28th; "Living Levers," December 30th; "Living Pumps," January 2nd; "Living Bellows," January 4th; "Living Workshops," January 6th; "Living Central Exchanges and Wires," January 9th. The lecture hour is 3 o'clock. The following are among the lecture arrangements before Easter:—Prof. C. S. Sherrington, six lectures on "The Old Brain"; Prof. W. E. Dalby, two lectures on "The Structure of Metals"; Prof. F. G. Donnan, three lectures on "The Mechanism of Chemical Change"; Prof. J. A. Fleming, two lectures on "Modern Improvements in Telegraphy and Telephony: (1) Telegraphy; (2) Telephony." The Friday evening meetings will commence on January 19th, when Prof. Sir James Dewar will deliver a discourse on "Soap Bubbles of Long Duration."

Educational.—A Committee has been appointed by the Treasury to report upon the system of examination for Class I of the Home Civil Service, and to submit a revised scheme to suit the requirements of the India, Foreign, and Colonial Offices, as well as the Home Service. Sir Alfred Ewing and Sir H. A. Miers, both scientific men of the highest eminence, are members of the Committee, their colleagues being Mr. H. A. L. Fisher and Prof. W. G. Adams, representing classical studies, and Mr. Stanley Leathes, First Civil Service Commissioner, as chairman.

SWANSEA COLLEGE.—At a meeting held to promote the claims of Swansea Technical College to be raised to University status (which application is being considered by the Royal Commission on Welsh University Education), subscriptions to the endowment fund were announced amounting to £71,000.

CITY AND GUILDS OF LONDON INSTITUTE.—The report of the Department of Technology for the session 1915-16 shows that the number of students in attendance was 35,203, compared with 55,996 in 1913-14, and the number of candidates for examination was 8,508, compared with 23,119, the number of passes being 5,239, compared with 14,570. Many students after commencing work were unable to complete their course and come up for examination, and many registered classes had to be discontinued owing to the falling-off in the number of students in attendance. At centres in one district an air raid, on May 2nd, necessitated the suspension of the examinations, and the rising in Ireland hindered the holding of the examinations at the regular dates. For the first time on record the examinations were held on foreign soil, 12 candidates being examined in Telegraphy and three in Telephony at Havre. A candidate in Telegraphy was examined on board H.M.S. *Queen Mary*. For the special examination in Magnetism and Electricity which the Institute holds by arrangement with the Postmaster-General, only 385 candidates presented themselves, as against 664 last year. Some suggestions and criticisms having been made in regard to the syllabus in Electric Wiremen's Work, a conference was arranged between Mr. W. R. Rawlings and Mr. W. Ellerd Styles, representing the Electrical Contractors' Association, and Prof. T. Mather, F.R.S., and Mr. Hawkins, representing the Institute, as the outcome of which a revised syllabus, under the modified title of "Electrical Installation Work," has been adopted, and now appears in the programme for the next session. Emphasising the importance which technical instruction of artisans will have in the near future, the report says:—

"A vague opinion that all is not well with the technical training of our working population is, no doubt, widely held, but much more is necessary, and the time for mere discussion of the problem is past. Speaking generally, employers must change their attitude towards technical training, so that those who foster the education of their younger employés should become the great majority instead of the minority, and so that attendance at continuation schools and day schools, or if this be too much to expect, at least at evening technical classes, should become the rule. Nothing short of a strong national movement in this direction can prove adequate to meet the requirements of the case. What has been said above is sufficient to show that there is need for reform in the primary school, in the secondary school, in the technical school, and in the University, not with a view to turning men into machines, but to provide them with the raw material of knowledge, which they need for intellectual development."

Fatalities.—Coroner H. Rutherford held an inquiry at Coxlodge, Northumberland, on the 5th inst., into the circumstances attending the death of George Soulsby, aged 20, a fitter's apprentice, who was employed by the Burradon and Coxlodge Coal Co., at Hazelrigg Colliery. The evidence of M. Dickinson, the engineman, was to the effect that on Sunday morning, the 3rd inst., Soulsby went into the engine house, and witness imagined that he was looking round to see that all was right. Witness went out for a couple of minutes, and on his return found Soulsby lying on the floor on his back. The use of artificial respiration was unavailing. On examining the place witness found that Soulsby had been interfering with the electric controller. He had opened the box and come into contact with the current. M. Richardson, the enginewright, stated that he instructed Soulsby to "blow out" the motor, but he did not intend that the youth should have cleaned the contacts, because he knew Soulsby would not have time, although he was quite capable of doing it. A verdict was returned that Soulsby had been accidentally killed while attempting to open the electric controller before cutting off the main switch.

Appointment Vacant.—Tramway traffic superintendent for the Pontypridd U.D.C. (£150). See our advertisement pages to-day.

Trade with Italy.—The representative of a firm in Rome is at present in London with a view to getting into touch with United Kingdom manufacturers of the undermentioned goods, and arranging to represent them on the Italian market:—Electrical fittings, hardware and tools, &c. Particulars from the Secretary, Statistical and Information Department, London Chamber of Commerce, 97, Cannon Street, E.C.—*Board of Trade Journal.*

A New Triangulation Signal Lamp.—Though the general principle employed in geodetic surveys is the same as in the survey of a railroad, a farm, &c., the great distance between the points, varying between 10 and 100 miles, or over, requires not only the use of specially large and refined instruments, but also a special means of making the point visible to the observer. This is now done in day time by reflecting sunlight to the observer from a mirror placed accurately over the point, and at night by means of a specially constructed acetylene lamp. Distances of the magnitude mentioned can be penetrated by either means only under favourable weather conditions, and many days during a season are lost even when the atmosphere is only slightly clouded by smoke, fog, &c.

The storage cell was studied by the United States Coast and Geodetic Survey with the view of using electricity as a source of light. Its cost and weight, and the difficulties connected with its maintenance, were found to be too great. Electric generators, with the necessary prime motor, were found to be too heavy for transporting to difficult stations.

The result of a series of tests of dry cells, which are readily divisible into loads suitable for climbing different ascents, however, warranted the design and construction of a new type of lamp, the use of which will increase the number of observing nights per month by at least 25 per cent.

The main part, an ordinary automobile head light, is suitably mounted for directing in horizontal and vertical planes; the lamp is provided with an ammeter, a small rheostat, and a switch. The whole, packed in a strong case, weighs 23½ lb.

In order to obtain most nearly the maximum intensity of the light, it was necessary that the lamp should be provided with a filament concentrated to a degree not found in those on the market. A lamp manufacturer was induced to make the necessary designs and experimental tests, and submitted a number for trial.

The use of the dry cell was found practicable, and not too costly, on the assumption that the proposed lamp was to be kept burning throughout the night. The trial of the newly-designed lamp, by comparison with the present acetylene lamp, however, proved the former so much superior, that it was decided to have the lights shown only on signal, flashed with one of the new lamps by the observer, for the few minutes each time it is observed upon. This reduces very materially the consumption of current and battery cost. The lamp, after being provided with two additional bulbs, one for medium and one for short distances, was tested by the Bureau of Standards, with the following results:—

Apparent candle-power, at a distance of 100 ft.	
Lamp with specially concentrated filament, gas filled, 6 volts, 2·5 amperes	250,000
Automobile lamp, 6 volts, 1·8 amperes	50,000
Flash-light lamp, 2·7 volts, ·34 ampere	6,000

The candle-power of the acetylene lamp now used in the triangulation carried on by the Survey, measured under the same conditions, is 1,500.—E. G. Fischer, in *Science*.

Glass Manufacture.—A department of glass technology at the University of Sheffield has been organised with the financial support of the Advisory Committee of the Privy Council for Industrial Research, of the Ministry of Munitions, and of the glass manufacturers of South Yorkshire. An actual glass factory will be established, in which operations will be done on a large, semi-commercial scale. The model factory will be equipped with pot furnaces and a small tank furnace and a series of experimental furnaces, including a number of electrically-heated ones and some heated by gas.—*The Times*.

The Coal Trouble in Australia.—A Reuter dispatch from Melbourne, dated December 2nd, stated that manufacturers throughout Australia were to be supplied with motive power, as from Monday last, thus enabling the factories to re-open, conditionally on their closing down for 10 days for the Christmas and New Year holidays. The full train and tramcar services were being restored.

Electrical Trades Union.—The address of the secretary of the London Station Engineers' branch is 7, Levendale Road, Forest Hill, S.E.

Volunteer Notes.—First London Engineer Volunteers.—Headquarters, Chester House, Eccleston Place.—Orders for the week by Lieut.-Col. C. B. Clay, V.D., Commanding.

Monday, December 11th.—Technical for Platoon No. 9, at Regency Street. Squad and Platoon Drill, Platoon No. 10. Signalling Class. Recruits' Drill, 6.25—8. Lecture, "On Telephones," 7.30.

Tuesday, December 12th.—School of Arms, 6—7. Lecture, 7.15, "The Service of Protection," Company Commander Hynam.

Wednesday, December 13th.—Instructional Class, 6.15. Platoon Drill, Platoon No. 1.

Thursday, December 14th.—Platoon Drill, Platoon Nos. 5 and 6. Ambulance Class by M.O., 6 o'clock.

Friday, December 15th.—Technical for Platoon No. 10, Regency Street. Squad and Platoon Drill, No. 9. Signalling Class. Recruits' Drill, 6.25—8.25. Lecture, "On Telephones," 7.30.

Saturday, December 16th.—N.C.O.'s Class, 2.30. Company Commander Hynam.

Sunday, December 17th.—Entrenching at Otford. Parade at Victoria (S.E. & C. Railway Booking-office), 8.45 a.m.

(By order) Macleod Yearsley, *Adjutant*.

New Finnish Hydro-Electric Company.—Application has been made to the Ministry of Trade and Industry for the approval of the statutes of a new company formed in order to construct and exploit electrotechnical works at Imatra-Volchoff under the name of "Vodopad." The founders are two share companies: the Petrograd Electricity Transmission Co. and the Finland Power Co. The object of the new company is to exploit the Imatra and Volchoff waterfalls, and to transmit the power generated to Petrograd, to be distributed to local factories and for illuminating the capital. The founders are asking power to expropriate land, and permission, with an original capital of 8,000,000 roubles, to issue Government-guaranteed bonds to the extent of nine times the capital named—that is, 72,000,000 roubles—to bearer. The project has been carefully examined by a special Conference, and has now been sent to the Finland Senate for a decision.

British-made Tungsten.—The shortage of tungsten following the outbreak of war—owing to our former dependence on Germany for supplies—rendered it essential to produce the metal in this country, for use in the manufacture of high-speed steel, and a Committee of steel manufacturers representing some 30 firms erected a factory in Lancashire for the purpose early in 1915. Since July last year the work has been carried on continuously day and night, and an average output of 3 tons a day has been obtained. The tungsten powder has averaged 98½ per cent. pure, and much of it over 99 per cent., compared with about 97½ per cent. for the German product. The company, which is known as High-Speed Steel Alloys, Ltd., has purchased a wolfram mine in Burma, and is improving its plant to deal with all kinds of low-grade ores. So there is no fear of a shortage of metal filaments!

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—Mr. L. A. Thain, charge engineer at the Bridlington Corporation electricity works, has resigned, having secured an appointment at Swansea.

A proposal by the Barrow Corporation Electricity Committee that the salary of Mr. H. R. Burnett, borough electrical engineer, be increased from £550 to £600 per annum as from January 1st last, has been referred to the General Purposes Committee of the Town Council for consideration.

The Aberdeen Electricity Committee has agreed to an advance of £25 in the salary of the chief clerk at the electricity works. The wages of many employés at the works are to be advanced as from the date of their applications in October.

The Erith U.D.C. has advanced the salary of Mr. J. C. Williams, the engineer and manager, by £50 per annum; that of Mr. L. H. Saynor, departmental electrical engineer, by £25; that of the chief clerk (Mr. H. A. Munday), by £16; and other officials by £10 and under.

General.—Mr. Wm. Stapleton, assistant electrician at the power house, Clonmel Asylum, has been appointed to the charge of the Fethard (Co. Tipperary) electric lighting plant.

The *Manchester Daily Dispatch* states that Mr. F. A. Carmichael has been appointed Chief Superintendent of Telegraphs in Manchester, and Mr. J. Wadsworth superintendent. Mr. C. Biddolph has been promoted to the position of Assistant Superintendent, Class I.

London Gazette Notice.—Territorial Force: Royal Engineers. Tyne Electrical Engineers. Staff-Sergeant G. T. B. Scullard and Staff-Sergeant F. Thompson to be Second-Lieutenants (on probation).

Mr. Alan Williams, M.I.E.E., has been appointed temporary Lieutenant, R.N.V.R., for special electrical engineering duties.

Coun. W. H. Dawson has been appointed Chairman of the Woolwich B.C. Electricity Committee.

Mr. G. W. Eyre has been reappointed Chairman, and Mr. A. G. Crowle Vice-Chairman, of the Plymouth Corporation Electricity and Street Lighting Committee.

Coun. Dagnall has been elected Chairman, and Ald. Walker Deputy-Chairman, of the Manchester Corporation Electricity Committee; and Ald. Bowes Chairman, and Ald. Chapman Deputy-Chairman, of the Tramways Committee.

Coun. Mayne has been re-elected Chairman of the Newcastle Corporation Tramways Committee, and Coun. A. Munro Sutherland Vice-Chairman.

Mr. H. Sellers has been appointed Chairman of the Keighley Electricity Committee, and Mr. J. Mullen Chairman of the Tramways Committee.

Ald. J. P. Smith has been appointed Chairman and Col. Wadham Vice-Chairman of the Barrow Electricity Committee.

Roll of Honour.—Lance-Corporal Charles Ramsey, Royal Engineers, who at the time of enlisting was an electrical engineer with the Palmer Iron and Steel Shipbuilding Co., Jarrow, has been awarded the Military Medal for bravery on the field.

Private John Nugent, R.M.L.I., killed on active service, was a fitter at the British Westinghouse Works, Trafford Park.

Sub-Lieutenant E. A. Gordon Harvie, R.N.V.R., killed on November 13th, aged 30 years, was, according to the *Times*, educated at Winchester, and trained as an electrical engineer at the Central Technical College, South Kensington.

Large numbers of electrical men will desire to tender their sympathy with Mr. T. P. Wilmshurst, borough electrical engineer at Derby, on the death of his second son, Lieutenant Edwin Roy Wilmshurst, Royal Fusiliers, who died of wounds on December 1st, aged 21. According to the *Times*, he was one of three brothers who enlisted when war broke out. They were all wounded, and afterwards obtained commissions.

The Barrow electrical engineer, Mr. H. R. Burnett, recently reported the death in action of another member of his staff, Mr. L. McKechnie, a switchboard attendant, and that Mr. R. Williams, jointer in the mains department, had been awarded the Military Cross.

Sergeant W. J. Bennett, of the Royal Engineers, wounded, was before enlistment a wireless telegraph instructor in Liverpool.

Sapper W. G. Scowens, R.E., who has been wounded for the second time, is the eldest son of Mr. J. R. Scowens, of the Folkestone electricity supply works. He was first on the staff of the Electricity Supply Co. at Hythe, and later electrical engineer at the Hotel Metropole, at Folkestone.

Private Lewis Henry Horne, who belongs to Exmouth, and was an electrician in Canada, is reported missing since an engagement on September 13th last.

Private B. Bowditch, Hants Cyclists, attached to the Dorset Regiment, who was with Messrs. Aish & Co., electricians, Bournemouth, has fallen in action.

Rifleman Harry Archer, Queen's Westminsters, who enlisted from the staff of Mr. Morton Crouch, electrical engineer, Bromley (Kent), has died from blood poisoning following wounds received in action.

Lance-Corporal R. Coupe, Loyal North Lancashire Regiment, attached to the Manchester Regiment, reported wounded and missing since July, was with Messrs. Dick, Kerr & Co., Ltd., of Preston.

Lance-Corporal B. Mills, Lancashire Fusiliers, assistant electrician at the Acme Spinning Mill, Pendlebury, has died in France, aged 22, of wounds received in action.

The Military Medal for bravery in action has been awarded to Private A. Draffin, R.A.M.C., who enlisted whilst on the Hull Corporation tramway staff.

Private F. W. Peterson, Royal West Kent Regiment, who has fallen in action, was a charge engineer at the L.C.C. generating station at Forest Hill.

The following is a list of casualties, promotions, &c., of the staff of the County of London Electric Supply Co., Ltd., with the Forces:—

Killed.—Rifleman A. Deeth, 21st Co. of London Regiment, mains department, "wounded and missing."

Lance-Corporal A. Rose, 5th Royal Berkshire Regiment, mains department, missing.

Lance-Corporal C. Wilson, K.R.R., mains department, killed on the Somme.

Private E. Alexander, 3rd East Surrey Regiment, generating department, killed in action.

Private W. Amey, Middlesex Regiment, killed in action.

Second-Lieutenant D. A. Lardner, 9th Bedfordshire Regiment, secretarial department, killed in action.

Lance-Corporal G. Tebby, Queen's Royal West Surrey Regiment, died of wounds on the Somme.

Rifleman A. B. Watkins, L.R.B., mains department, killed in action.

The following have been wounded:—

Lance-Corporal G. F. Ayling, of the secretarial department, wounded and prisoner of war in Germany.

Rifleman W. E. Dossett, mains department, wounded.

Corporal W. Goldsmith, mains department, gassed.

Private J. Lindfield, mains department, wounded.

Sergeant H. Clarke, mains department, wounded.

Lance-Corporal E. Goodyear, mains department, severely wounded.

Rifleman T. E. Maylam, mains department, wounded.

Rifleman S. Perry, mains department, wounded.

Private J. Pulham, jun., mains department, wounded.

The following have received commissions:—

H. F. Gill, secretarial department, as Second-Lieutenant, R.E. (Wireless Section).

N. A. Dunk, secretarial department, as Lieutenant, Royal Ordnance Corps

J. J. Lightfoot, secretarial department, as Second-Lieutenant, R.E. (Wireless Section).

The Military Cross has been awarded to H. F. Gill, R.E., of the secretarial department.

Obituary.—Mr. W. A. Walton.—The death is reported, at the age of 52 years, of Mr. William A. Walton, electrical engineer to the Gloucester Railway Carriage & Wagon Co., who had been with the company for over 30 years.

NEW COMPANIES REGISTERED.

Wolf Safety Lamp Co. (Wm. Maurice), Ltd. (145,428).—This company was registered on November 30th, with a capital of £6,000 in 2,000 pref. shares of £1 each and 80,000 ord shares of 1s. each, to acquire the business of the Wolf Safety Lamp Co., and to carry on the business of manufacturers of and dealers in lamps of all kinds, manufacturers of, agents for, and dealers in accumulators and other bases for incandescent electric lamps, electric lamp fittings, electrodes, batterics, dynamos, motors, transmission systems, and electrical plant &c. The subscribers (with one share each) are: W. Maurice, Goldthorpe, Mushroom Lane, Sheffield, mining engineer; F. J. Conway, 21, Upper Albert Road, Meersbrook, Sheffield, mechanical engineer. Private company. The number of directors is not to be less than three or more than five. W. Maurice is permanent governing and managing director and chairman. Qualification, £50. Registered office: Star Works, Boston Street, Sheffield.

Woods-Gilbert (British) Rail Grinding & Milling Co., Ltd. (145,417).—This company was registered on November 29th, with a capital of £10,000 in £1 shares (5,000 10 per cent. cum. pref.), to take over the business and undertaking, and all or any of the assets, contracts, and liabilities in Great Britain or elsewhere of the Woods-Gilbert Rail Planer Co., Ltd. (incorporated in Victoria, Australia), and to carry on the business of contractors, electrical and mechanical engineers, patentees, and manufacturers of rail grinding, milling, and planing machines, tool makers, founders, &c. The subscribers (with one share each) are: H. R. Collings, c/o the Colonial Bank of Australasia, Ltd., 33, Bishopsgate, E.C., gentleman; J. Cameron, Colonial House, Tooley Street, S.E., agent. Private company. The first directors (to number not less than three or more than five) are: The Hon. Sir John Taverner, K.C.M.G., J. Cameron, and H. M. Collins, who may hold office until 1919 unless previously removed therefrom with the consent of the Woods-Gilbert Rail Planer Co., Ltd., of Melbourne. Qualification, 100 preference shares. Remuneration (except managing director), two guineas each per board meeting attended. Solicitors: Blyth, Dutton, Hartley & Blyth, 112, Gresham House, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Micanite & Insulators Co., Ltd.—Particulars of £25,000 debs., created by resolutions of March 18th, 1908, March 20th, 1912, and November 20th, 1916, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the amount of the present issue being £16,000. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Cutting Bros., Ltd.—Issue on November 10th, 1916, of £1,550 debs., part of a series of which particulars have already been filed.

Wakelins, Ltd.—Memorandum of deposit dated November 17th, 1916, charged on moneys payable under certain contracts, to secure all moneys due, or to become due, from the company to London & South-Western Bank, Ltd., 170, Fenchurch Street, E.C.

Bankfoot Power Co., Ltd.—A memorandum of satisfaction to the extent of £5,600 on September 30th, 1916, of debs. dated May 12th, 1911, securing £50,000, has been filed.

James Keith & Blackman Co., Ltd.—A memorandum of satisfaction in full on November 13th, 1916, of charge dated August 19th, 1909, securing £2,000 has been filed.

Liverpool Electric Cable Co., Ltd. (71,099).—Capital, £20,000 in £1 shares. Return dated July 27th, 1916. All shares taken up; £7,833 paid; £12,167 considered as paid. Mortgages and charges: Nil.

General Accessories Co., Ltd. (104,464).—Capital, £3,000 in 1,580 6 per cent. pref., 920 5 per cent. ord., and 500 ord. shares of £1 each. Return dated August 7th, 1916. All shares taken up; £1,580 paid; £1,420 considered as paid. Mortgages and charges: Nil.

Salford Electrical Instruments, Ltd. (112,599).—Capital, £20,000 in £1 shares (10,000 pref. and 10,000 ord.). Return dated September 27th, 1916. All shares taken up. £10,000 paid on the pref.; £10,000 considered as paid on the ord. Mortgages and charges: Nil.

CITY NOTES.

Amazon Telegraph Co., Ltd.

Mr. C. W. Parish presided at the meeting, held on November 28th. He first referred to the death of Mr. G. Keith, the chairman and managing director. For the past two years he had had to refer to a serious falling off in the Amazon rubber crop. In the past twelve months there had been a slight improvement, the rubber production being increased by 1,365 tons, and greater fluctuations in the price had tended to increase the company's business. The traffic receipts increased by £3,749, due to an improvement in business during the last half of the financial year and to an increase of 10 per cent. in local rates which automatically came into force on April 1st, 1916, owing to the fall in traffic during 1915. Expenses at stations decreased by £1,201, partly due to the lower rates of exchange, and maintenance of cables decreased by £1,929. The gross profit was £29,880, as against £22,994. Mr. Nosworthy, who had been elected to fill the vacancy caused by the death of Mr. Keith, and had been appointed managing director and knew everything about the company's business and cables by reason of his control of the system on the Amazon, seconded the adoption of the report. In the course of his speech, as reported in the *Financial Times*, he recalled that the first cable worked a very short time before parts of it became interrupted; half its length had to be relaid about 18 months afterwards, and the new cable also was subject to repeated interruption. The experience thus gained had enabled them to overcome many difficulties, and to-day a very good service was maintained. The service was much improved by the duplication in 1906 of the uppermost section, some 76 miles long, which was most subject to interruption. Experience showed that the only means of maintaining a satisfactory service was to have two cables the whole way between Para and Manaos, and in 1907 he was instructed to make surveys to find, if possible, a new route entirely apart from the main river, or as nearly so as could be. Two years were spent on the survey, and a suitable route was found. The new cable had a length of 1,094 miles, of which only 146 miles were in the main river, the remainder being in lakes and small rivers where there was shallow water, perfect bottom, and next to no current; and some 28 miles of underground cable was laid,

mostly through virgin forest. Many of the streams were never used, except perhaps by canoes, and had become completely blocked with floating islands, through which they had to cut their way. Since its completion this cable had been interrupted 28 times. Of this total, five were due to damage by natives and five occurred in the cable of the 1906 upper section duplication, part of which was incorporated in the main duplication. Consequently in six years there had been only 18 breaks in the 1910 duplication, which was an exceedingly small average, so that the route selected might be considered successful. It was very rare for through communication to be interrupted. As to their prospects, he thought the worst was passed. The price of rubber, present and prospective, was remunerative. The States Governments were encouraging agriculture, and Brazil generally appeared to be making some recovery from its financial crisis.

Electrical Securities Trust, Ltd.—The report for the year to November 14th states that the results for the period, after charging all expenses and the interest due and accrued on the debentures, amounting to £2,276, show a loss of £564. No credit has been taken in the accounts for interests or dividends which may have accrued and which have not been paid within the period of the accounts. The directors regret that they have been unable to dispose of any of the investments held by the Trust during the past year, but out of cash in hand the trustees, on December 23rd, 1915, made a further distribution of 5 per cent. on the debentures.—*Financial Times.*

Companies to be Struck Off.—The following companies are to be struck off the Register unless cause to the contrary is shown within three months:—

Electric Stores, Ltd.
Hammersmith Welding, Engineering & Electrical Co., Ltd.
New Electric Rifle & Target Co., Ltd.
Panama Electric Light, Power & Traction Co., Ltd.
Telephone Instalment System Co., Ltd.

United Wire Works, Ltd.—The report for the year to September 30th states that, after providing for depreciation, bad debts, and excess profits duty, the profit is £13,702. Dividend, 7½ per cent. on the ordinary shares, free of tax; £1,500 to general reserve fund, leaving £3,302 to carry forward.

Callenders' Share & Investment Co., Ltd.—The accounts for the year show, after providing for debenture stock interest &c., and including £3,010 brought forward, £11,292 available, as compared with £10,876. A further dividend of 2½ per cent. is recommended, making 5 per cent. for the year, transferring £500 to reserve, and carrying forward £4,175.

Adelaide Electric Supply Co., Ltd.—Final dividend of 5 per cent., making 10 per cent. for the year, together with a bonus of 2 per cent., both free of income-tax, on the ordinary shares for the year ended August 31st.

Dartmoor Electric Supply Co., Ltd.—Notice appears in the *London Gazette* of December 1st respecting the reduction of capital of this company from £4,000 to £2,000.

Brazilian Traction, Light & Power Co.—The directors have declared a quarterly dividend of 1½ per cent. on the fully-paid cumulative preference shares.

United Electric Tramways of Monte Video, Ltd.—Interim dividend on the pref. shares for the half-year ended September, 1916, at the rate of 6 per cent. per annum, less tax at 5s. in the £. No interim dividend on the ordinary shares for the half-year.

Power Gas Corporation, Ltd.—Profit for the year ended September 30th, 1916, £21,192, plus £9,105 brought forward. Dividend, 6 per cent. on the ordinary shares, less income-tax. £11,120 is to be carried forward, out of which excess profits duty, if any, will be met.

Chloride Electrical Storage Co., Ltd.—Interim dividend, 1s. per share, free of tax, on the ordinary shares.

Melbourne Electric Supply Co., Ltd.—Final dividend of 5 per cent., making 10 per cent. for the year, free of income-tax, on the consolidated ordinary stock.

Western Telegraph Co., Ltd.—First quarterly dividend, 3s. per share, free of tax, for the year ending June, 1917, being at the rate of 6 per cent. per annum.

STOCKS AND SHARES.

Tuesday Evening.

The political crisis has had a slightly enervating effect upon prices in the Stock Exchange, although, as business men, members of the House would welcome any sort of change that is likely to expedite the conduct of the war and hasten its termination. The most immediate influence is still the position of affairs in Greece and Roumania. Having regard to the uncertainty which still exists at the time of writing in both theatres, it is not very surprising that there should be a pronounced disinclination on the part of the public in the direction of investment and speculation alike.

This disposition is accentuated by the usual December desire to indulge in mild window-dressing, which leads capitalists, large and small, to postpone investment of surplus funds until the year is turned. This time they have the additional excuse that they are waiting for the advent of the new war loan. The sarcasm that the Government is likely to defer the next loan till such time as the news is much more than it is now, carries more acid than point, because, although it is unfortunately true that the Government missed its market badly in the autumn, it is equally true that to float a big loan during the last weeks of the year would be to crab pretty much its chances of success.

The Home Railway market continues in a sagging condition, and day by day the prices of the Steam stocks dwindle. This tendency has spread to the Undergrounds, where prices are scarcely so firm as they appear. Recent buyers of the £10 shares of the Underground Electric Railways are doing their best to snatch what profit remains to them; and the price, which was 2 5/16 ten days ago, is once more a trifle under 2, while in the shilling shares, which now stand at 6s., there is very little doing. The advance in wages conceded to the miners, and the threat that even this is not sufficient to satisfy the demand of those gentlemen, is the latest restraint laid upon hopefulness in this department.

The electric lighting market is quiet. What little pressure to sell was noticeable last week has been relaxed to some extent, and the assumption is that holders of illumination securities are looking with subdued expectation upon the campaign which is being carried out with a view to increasing the lights of London. Having regard to the alarming number of street accidents, the strong probability that the Zeppelin raiders are not likely to repeat their costly visits for some time, and the sentimental feeling that there is something undignified in London's still sheltering under its pall of darkness, it is hoped that the authorities may see their way to modify the stringent regulations at present in force. Westminsters are 1/16 down; so are South Londons. City of London ordinary are offered about 11⅛. But on the whole, the approach of the end of the year is an inducement to proprietors to retain their shares rather than to try to sell them at low prices so shortly before the next batch of dividend announcements.

Last week's meeting of Reuters shareholders confirmed the sale of the company's shares at £11 per share, which is just double the price at which Reuters were standing not so very long ago. The lowest touched this year was £4, and last year the price fell to 3. The last dividend paid by the company was 8s. a share, in May, 1914; so that, taking everything into account, it seems to us that the shareholders may heartily congratulate themselves upon having such an excellent price offered them. When the last 10 per cent. dividend was paid, in 1912, a certain amount of criticism was launched at a distribution of profits which looked rather extravagant at the time. However, this is now a matter of history; and proprietors are lucky to get out so comfortably.

Brazilian Tractions again broke severely upon a fall in the Brazilian rate of exchange to a small fraction below 1s. The price touched 45¾, showing a drop of 5 points in less than a week. Support forthcame at this level, and a recovery ensued to 47, which still leaves Tractions substantially lower on balance. The preferred have fallen 3 to 86. Rio exchange firmed up to 1s., but most of the things connected with Brazil are dull and depressed.

Other issues in the Latin-Canadian group are mostly better. An extraordinary rise in the price of Otis Steel carried the shares to 100, as compared with the low-water mark of 25 this year and 10 in 1915. The rise is associated with rumours to the effect that the company is to be taken over by one of the big corporations in America. Consolidated Gas & Electric of Baltimore shares have risen to 134, and from the look of the market it would seem to be wrong to sell them now. No recovery has occurred in British Columbia Electric stocks, and the Mexican group remains very flat, Government, railway, and industrial issues all being unfavourably affected. Mexican Light & Power preferred shares are 5 points down.

The telegraph market is heavy. Westerns receded to 14, and the Eastern group is dull with a 2-point fall in Eastern Telegraph ordinary. The strength of industrials in New York helps to maintain the prices of the Anglo-American division. Marconis moved narrowly between 2⅞ and 3, the flicker of excitement which put the price up to 3⅛ last month having died out. Great Northern Telegraphs lost their rise of a week ago. Globe Preference eased off to 10⅛. Telegraph Constructions show a loss of 10s. at 38.

The feature of the miscellaneous group is a rise of 7s. 6d. in the price of India-Rubber shares, taking them to 13⅛, at which the return on the money is still over 7½ per cent., with dividends paid free of income-tax. General Electric ordinary fell 5s. to 13¾. Callenders are good at 13. British Aluminiums are active, although there was a little profit-taking in the neighbourhood of 30s. The prior lien bonds of the British Westinghouse Co. drooped a trifle to 100, but the preference shares remain firm at 9 7/16. Castner-Kellners keep strong on the increase in the dividend; and Edison and Swan shares, after their activity about 8s. 6d., have settled down to a quiet time again.

Armament shares are easier, the report of the Armstrong Co. apparently causing a little dissatisfaction, in spite of the big figures which it disclosed. In the rubber market, a rise to 3s. per lb. in the price of the raw material had virtually no effect upon the quotations of shares, so slack has business become. Further improvements in the price of copper, break-

ing all records for recent years, had little influence, in consequence of the feeling that the metal market is being manipulated from America, which is taking the fullest advantage of the needs of the Allies in the matter of munitions.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1914.	Dividend 1915.	Price Dec. 5, 1916.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.					
Brompton Ordinary	10	10	6⅜	—	£7 11 0
Charing Cross Ordinary	5	5	3⅜	—	7 8 2
do. do. do. 4½ Pref.	4½	4½	3 7/8	—	6 11 0
Chelsea	5	4	3	—	6 18 4
City of London	9	8	11⅜	—	6 17 8
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	10½	—	6 13 4
do. 6 per cent. Pref.	6	6	10	—	6 0 0
Kensington Ordinary	9	7	6⅜	—	6 4 6
London Electric	—	4	3	—	6 10 5
do. do. 6 per cent. Pref.	6	6	4 7/8	—	6 15 4
Metropolitan	3½	3	2⅜	—	6 6 4
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	10	8	6½	—	6 8 0
South London	5	5	2⅝	— 1/16	6 17 6
South Metropolitan Pref.	7	7	1 3/16	—	6 7 3
Westminster Ordinary	9	7	6⅜	— 1/16	6 16 8
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	95½	—	6 5 8
do. Def.	30/-	33/6	23½	—	7 10 3
Chile Telephone	8	8	7⅛	—	5 12 3
Cuba Sub. Ord.	5	5	8½	—	6 8 6
Eastern Extension	7	8	13½	— ½	*5 16 6
Eastern Tel. Ord.	7	8	140½	— 2	*5 14 0
Globe Tel. and T. Ord.	6	7	12½	—	*5 12 0
do. Pref.	6	6	10½	— ½	5 18 5
Great Northern Tel.	22	22	37½	— ½	5 17 4
Indo-European	13	13	51	—	6 7 8
Marconi	10	10	2⅞	—	3 9 6
New York Tel. 4½	4½	4½	101	+3	4 9 0
Oriental Telephone Ord.	10	10	2 5/8	—	4 6 6
United R. Plate Tel.	8	8	6⅛	—	*5 16 5
West India and Pan.	1	6d.	1 1/16 xd	—	2 4 0
Western Telegraph	7	8	14	— ⅜	*5 14 4
Home Rails.					
Central London, Ord. Assented	4	4	65½	—	6 2 2
Metropolitan	1½	1	23½	— ¾	4 6 0
do. District	Nil	Nil	16	—	Nil
Underground Electric Ordinary	Nil	Nil	1 1/16	— 1/16	Nil
do. do. "A"	Nil	Nil	6/-	—3d.	Nil
do. do. Income	6	6	91	—	*6 11 10
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	4 1/16	—	6 1 6
Anglo-Arg. Trams, First Pref.	5½	5½	3½	—	8 9 2
do. 2nd Pref.	5½	5½	2⅜	—	—
do. 5 Deb.	5	5	67	—	7 9 3
Brazil Tractions	4	4	47	—1	8 10 2
Bombay Electric Pref.	6	6	10½	—	5 17 3
British Columbia Elec. Rly. Pfce.	5	5	69	—	7 5 0
do. do. Preferred	—	Nil	49	—	Nil
do. do. Deferred	—	Nil	47	—	Nil
do. do. Deb.	4½	4½	62	—	6 17 4
Mexico Trams 5 per cent. Bonds	—	Nil	32½	—	Nil
do. 6 per cent. Bonds	—	Nil	27⅞	—	Nil
Mexican Light Common	Nil	Nil	12⅜	—	Nil
do. Pref.	Nil	Nil	17½	—5	Nil
do. 1st Bonds	Nil	Nil	32½	—	—
Manufacturing Companies.					
Babcock & Wilcox	14	15	2 1/16	—	5 2 0
British Aluminium Ord.	5	7	30/-	—	5 6 8
British Insulated Ord.	15	17½	11⅜	—	7 5 10
British Westinghouse Pref.	7½	7½	2 7/16	—	6 8 0
Callenders	15	20	13 1/16	+ ⅛	7 13 10
do. 5 Pref.	5	5	4½	—	5 17 8
Castner-Kellner	20	22	8⅞	—	5 6 8
Edison & Swan, £3 paid	Nil	—	1/16	—	Nil
do. do. fully paid	Nil	—	1/8	—	Nil
do. do. 4 per cent. Deb.	5	5	69½	—	8 0 0
Electric Construction	6	7½	1½	—	6 13 4
Gen. Elec. Pref.	6	6	10	—	6 0 0
do. Ord.	10	10	13⅜	— ¼	7 5 6
Henley	20	25	16	—	7 16 3
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	13⅛	+ ⅜	*7 12 4
Telegraph Con.	20	20	38	— ½	*6 5 0

* Dividends paid free of income-tax.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Month ended (4 wks.)	Receipts for the month. £	Receipts for the month. £ Inc.	No. of weeks.	Total to date. £	Total to date. £ Inc.	Route miles open.	Route miles open. Inc.
Bristol (Trams)	Nov. 24	18,941	— 277	47	231,047	+ 9,613	30·5	..
Cork	,, 23	1,96	+ 161	47	24,091	+ 452	9·89	..
Dublin	,, 24	24,290	+1,767	47	286,584	+ 715	54·25	..
Hastings	,, 24	3,134	+ 208	47	49,258	+ 3,174	19·3	..
Lancashire United	,, 22	7,059	+ 812	47	86,392	+ 4,876	42	..
Llandudno-Col. Bay	,, 24	851	+ 93	51½	18,910	+ 1,221	6·5	..
Tyneside	..	..	..	..	..	..	..	..
Anglo-Argentine	,, 25	211,438	+ 452	47	2,401,981	+ 4,896	..	..
Auckland	Oct. 20	21,428	+ 597	16	84,285	+ 1,160	26·19	..
Calcutta	Nov. 25	18,862	+2,191	..	..	+11,437	..	..
Kalgoorlie, W.A.	Sept.	2,783	..	39	23,267	..	20.5	..
*Madras	Nov. 15	2,106	+ 143	45	41,567	+ 3,145	..	..
Montevideo	Nov.	28,404	— 8	..	..	..	..	..
Dublin-Lucan Rly.	Nov. 24	496	+ 53	21	3,566	+ 291	7	..

* Two weeks.

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, December 6th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Oxalic	per lb.	1/8	..
a Ammoniac Sal	per ton	£75	..
a Ammonia, Muriate (large crystal)	,,	£54	..
a Bisulphide of Carbon	,,	£23	..
a Borax	,,	£34	..
a Copper Sulphate	,,	£63	£3 inc.
a Potash, Chlorate	per lb.	2/6	..
a ,, Perchlorate	,,	2/-	..
a Shellac	per cwt.	140/-	..
a Sulphate of Magnesia	per ton	£16	..
a Sulphur, Sublimed Flowers	,,	£18	..
a ,, Lump	,,	£16	..
a Soda, Chlorate	per lb.	1/-	..
a ,, Crystals	per ton	130/-	..
a Sodium Bichromate, casks	per lb.	..	..
METALS, &c.			
c Brass (rolled metal 2" to 12" basis)	per lb.	1/5½ to 1/5¾	1d. inc.
c ,, Tubes (solid drawn)	,,	1/6¾ to 1/7	½d.—1d. inc.
c ,, Wire, basis	,,	1/5¾ to 1/6	1d. inc.
c Copper Tubes (solid drawn)	,,	1/10½ to 1/11	1d.–1½d. inc.
g ,, Bars (best selected)	per ton	£189	£11 inc.
g ,, Sheet	,,	£189	£11 inc.
g ,, Rod	,,	£189	£11 inc.
d ,, (Electrolytic) Bars	,,	£170	£10 inc.
d ,, ,, Sheets	,,	£188	£10 inc.
d ,, ,, Rods	,,	£179	£10 inc.
d ,, ,, H.C. Wire	per lb.	1/9	1d. inc.
f Ebonite Rod	,,	3/-	..
f ,, Sheet	,,	2/6	..
n German Silver Wire	,,	2/3	..
h Gutta-percha, fine	,,	6/10	..
h India-rubber, Para fine	,,	8/5	½d. inc.
i Iron Pig (Cleveland warrants)	per ton	Nom.	..
l ,, Wire, galv. No. 8, P.O. qual.	,,	£36	..
g Lead, English Pig	,,	£32 5	..
g Mercury	per bot.	£18 12 6 to £18 15	£1 inc.
e Mica (in original cases) small	per lb.	6d. to 8/-	..
e ,, ,, ,, medium	,,	8/6 to 6/-	..
e ,, ,, ,, large	,,	7/6 to 14/- & up.	..
d Silicium Bronze Wire	per lb.	1/11½	1d. inc.
r Steel, Magnet, in bars	per ton	£95	..
g Tin, Block (English)	,,	£190 to £191	£4 dec.
n ,, Wire, Nos. 1 to 16	per lb.	2/11	..

Quotations supplied by—

a G. Boor & Co.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons
r W. F. Dennis & Co.

U.S.A. Turbine Business.—Since the beginning of 1916 the demand for steam turbines has far outstripped anything in the past. A compilation made by the *Electrical World* from data furnished by the steam-turbine manufacturers discloses the fact that the volume of steam-turbine business already handled since the beginning of the current year exceeds 2,000,000 KW. in rated capacity. At this rate the total 1916 business should reach 3,000,000 KW. in turbine capacity.

At present the best deliveries that it is possible to obtain are eight months for some of the smaller sizes for pump and industrial use, a year to a year and a half on large industrial and ordinary central-station sizes, and two years for the very large sizes. Orders now on hand are sufficient to keep the entire manufacturing facilities in operation for considerably more than a year.

It has been roughly estimated that approximately 65 per cent. of the present business is for central-station equipment, 25 per cent. for industrial plants, including marine installations, averaging 300-500 KW., and 10 per cent. for pumping stations averaging 50 H.P.

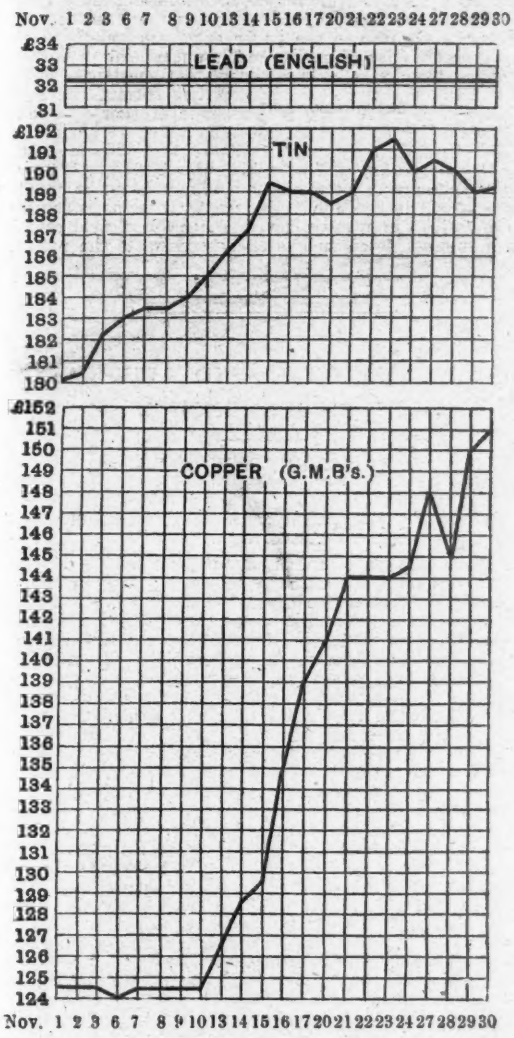
Many large units have been ordered since the beginning of the year, the tendency being towards machines of very large capacity. Notable in this respect have been orders for a 73,000-H.P. and a 60,000-H.P. unit, and an order for two cross-compound units of a total rating of 95,000 KW.

Both labour and material have been hard to obtain in satisfactory quantity and price, and both have greatly increased in price during the year. Turbine prices have, therefore, necessarily advanced.

Russia.—The 1886 Company Liquidation Puzzle.—According to the *Novoie Vremya*, in the opinion of V. P. Litvinoff, who has returned to Moscow from Petrograd after consulting there on the liquidation of the 1886 company, the question has been definitely decided. It is said that if hitherto the liquidation has not been proceeded with, it is because of the great importance of the concern and its close connection with work being done for the national defence, so that great care must be taken in handling the question of liquidation. The details of a scheme are now being worked out. It is denied that there are inter-departmental divisions of opinion as to how the liquidation should be effected, and it is clearly stated that the liquidation of the 1886 company is a matter of the near future.

METAL MARKET.

Fluctuations in November.



Electricity Supply in Germany.—In *l'Industrie Electrique* is given a summary of a scheme put forward by Prof. Klingenberg, President of the German Society of Electrical Engineers, for the development on the largest scale of the production and use of electrical energy and for the discouragement of the use of gas, by taxation, in order to further the adoption of electric motive power. He proposes to build a number of large, well-situated generating stations, which would distribute energy to existing stations at a pressure of 100,000 volts, these becoming, therefore, sub-stations; competition between the new and the old stations, however, must be avoided, as the latter represented in 1913 a capital of not less than 100 millions sterling. The State works would cost about 40 millions, and their output in 1926 would reach 400 million KW., while the net annual profit would rise to about 1·6 million pounds. The State would derive a revenue of more than 4·4 millions sterling from taxes imposed upon electric lighting, gas, hydraulic power, and coal, these taxes being specially calculated to encourage the use of electricity and to discourage the use of rival sources of motive power. The author estimates that after paying capital charges and taxes, there would still remain nearly two-thirds of the gross profit, which he believes would exceed 14 millions sterling per annum.

Inefficiency of Labour in the U.S.A.—According to the *Electrical World*, although wages in the electrical manufacturing industry are about 25 per cent. higher than before the war, about 20 per cent. less work is obtained per man, or for the same cost only 64·2 per cent. as much work is done. This is the result of an extraordinary demand for labour, leading to constant changes of situation on the part of the workmen, as well as to the employment of inexperienced and partially trained hands. Manufacturers who had had the foresight to establish pension and bonus systems have been more fortunate in keeping their shops full than their competitors. A company which requires 250 men for full output has employed 2,250 men during the past 10 months, yet it recently had only 220 men at work.

THE FARADAY SOCIETY.

General Discussion on Refractory Materials.

The Faraday Society opened its session on November 8th with a remarkable symposium and general discussion on "Refractory Materials." The President, Sir Robert Hadfield, F.R.S., who presided over the meeting, said its justification was the vital importance of refractories to so many national industries and the little attention the subject had received in recent years, as a result of which the scientific foundation required for healthy development was lacking. This view is evidently general, for the meeting attracted a very large audience from all parts of the country, representative of every interest concerned, whether geologists, makers of firebricks, iron and steel metallurgists, gas engineers or chemists. A comprehensive collection of exhibits, native and colonial minerals, and home-made refractory products, such as bricks, crucibles, furnace tubes, and laboratory ware, added to the attractions of the meeting, the sustained interest of which may be gauged by the fact of its extending over two sessions, from 5.30 to 11.30 p.m. It will be impossible here to do more than indicate in a very general way the nature of the discussion, for the number of contributions to it, in the form of papers, speeches, and written communications, exceeded 30, and the material when printed will fill a fair-sized volume.

The keynote of the meeting was co-ordination, both as regards workers and as regards knowledge; closer co-operation between the collector of raw material, the maker, and the user on the one hand, closer co-ordination between science and practice, between the research laboratory and the brick-maker and steel-maker on the other. A beginning of such co-ordination was made some years ago when a Joint Committee on Refractory Matherials was formed by the Institution of Gas Engineers and the Society of British Gas Industries. Dr. H. G. Colman, Chairman of this Committee, gave a short account of its work, which has consisted in drawing up most useful specifications relating to fire-resisting goods used in gas works, and also in carrying out investigations likely to help in improving the materials in the market. But the reference has been too limited to be of general value, and the means for carrying out research have been far too small for the end in view, although what has been done, under the skilled direction of Dr. J. W. Mellor, of Stoke-on-Trent, is known the world over for its accuracy, thoroughness, and value. There is hope now that in both these directions the meeting will have given a great impulse to more rapid progress.

Most useful, because most fundamental, was the information given by Mr. J. Allen Howe on the recent work of the Geological Survey in refractory materials, by Dr. A. Strahan, the Director of the Survey, and by Mr. T. Crook, of the Imperial Institute. These speakers made it clear that not only is this country well provided with most of the ordinary raw materials—silica, fireclay, refractory sands, and dolomite—required by the furnace-brick maker, but that the Empire, although perhaps not entirely self-contained, is well provided with resources in the less common refractories, such as graphite, chromite, magnesite, bauxite, and zircon. All this information—accompanied by exhibited specimens—was both helpful and timely, and the promised reports of the Geological Survey, containing not only details of the locality and nature of the deposits that have been surveyed, but also the results of the chemical, petrological, mineralogical, and textural examinations that have been made of 1,500 or more samples collected, will be awaited by firebrick, crucible, and retort makers with keen interest.

The group of papers with which the symposium opened dealt largely with the question of the nature and composition of firebricks and the relation between refractoriness on the one side and texture and chemical content on the other. Three aspects of this side of the subject were discussed: First, the importance of analysis; secondly, the necessity for "mechanical" analysis, that is, dividing up the material into its physical constituent parts before proceeding to chemical analysis; and thirdly, the value of an examination into the texture of firebricks, either microscopically or in other ways. With regard to the first, mention must be made of the most useful series of tables, giving complete analyses of most of the refractories in common use, which Sir Robert Hadfield appended to his opening address. On the second point, we would only mention Dr. R. Lessing's very lucid explanation of how he electriates refractory mixtures into their component parts in a simple apparatus by means of a gentle current of water. Mr. A. B. Searle (Sheffield) emphasised the secondary importance of chemical analysis to physical and microscopical tests. Dr. J. W. Mellor spoke chiefly on the texture of firebricks. He showed how this can be controlled by the manufacturer, and what texture should be arrived at for the different purposes in view. To exhibit the various types of texture, he showed a set of firebricks cut transversely, and with their exposed faces polished. Prof. W. G. Fearnsides, of the University of Sheffield, in an extremely interesting speech, described how he "slices" bricks for microscopical examination of texture, and how much can be learned from such study, whether before the brick has been used or after it has completed its life's run in the lining of a furnace. Mr. Cosmo Johns (Sheffield), in a

speech of exceptional importance, also spoke on this question, particularly as it bears on the silica bricks used by the steel maker, urging the study of the effect of texture by varying grain-size, and correlating it with refractoriness and other properties. He also discussed the changes bricks undergo under furnace conditions.

Several speakers dealt with the classification of refractory materials. Mr. C. P. Page in particular discussed this from the point of view of their behaviour under furnace conditions. The usual classification into acid, basic, and neutral materials is convenient, but arbitrary and inaccurate. The refractory has two conditions to contend against, heat and chemical action, and refractoriness towards the one has no relation to that against the other. So-called acid refractories are used where it is a case of refractoriness towards heat because they are plentiful and cheap; basic and neutral materials are less widely distributed, and are often difficult of application. Classification was also one of the themes of the very interesting speech of Dr. P. G. H. Boswell, of the Geological Department, Imperial College of Science and Technology, particularly with regard to refractory sands, our resources in which were indicated by him. It appears that the high silica sands (carrying over 99 per cent. SiO_2) and the aluminous sands (70-80 per cent. SiO_2 up to 15 per cent. Al_2O_3), although largely imported from abroad, are yet plentiful and accessible in this country. But for the green sands, or moulding sands, used for casting steel, we must still rely on oversea supplies—largely because *we do not at present know the exact properties* of this material, a subject on which Dr. Boswell himself is, fortunately, working.

The point of view of the manufacturer was ably put by Mr. Albert Cliff, of Stamford, and, by correspondence, by Mr. W. Donald (Glasgow), Mr. T. Allen (Dudley), and Mr. F. Deansfield (Oldham). Mr. Cliff made various suggestions as to the directions in which improvements in manufacture were possible. One was in the working-up of old material. Some of the present shortage of supply he was overcoming by fastening non-corrodible working surfaces, such as chromite or magnesite, on to ordinary firebricks. Finally, he made an eloquent appeal for co-ordination between the chemists and the manufacturers, and to the men of science to come down to the works districts and talk freely to the young people, and so accelerate a rise of specialised intelligence. Both Prof. Fearnsides and Mr. Cosmo Johns told of the valuable information locked up in works in the skill and knowledge of the foremen. The men of science should go through the works and translate this knowledge into their own more universal language. Mr. Donald told how he was endeavouring to approximate the pure Greek magnesite to Austrian magnesite by adding a small percentage of Fe_2O_3; he also criticised the present use of dolomite in conjunction with magnesite in basic steel furnaces, and he attributed to this cause much of the trouble in these furnaces. Incidentally, he mentioned the possibilities of Serbia, with its minerals and plentiful water-power, as an electrometallurgical centre. Mr. T. Allen spoke of the inconclusive character of laboratory tests, but unfortunately, works tests often took years to realise. Mr. Deansfield raised an important problem in the conservation of national resources in drawing attention to the enormous loss of refractory clays lying under coal seams due to the winning of the coal only. Some interesting points of practice were given by Mr. Alleyne Reynolds in his communication. Mr. Reynolds, as did Dr. Mellor before him, threw scorn on the possession of so-called "trade secrets," which impeded progress and, in the end, were most harmful to any industry. The plea for co-ordination was also strongly urged by Mr. W. J. Jones, of the Ministry of Munitions, and Mr. A. A. McDougall Duckham, of the same Ministry, emphasised how much the output of munitions depended on refractories.

Finally, several papers and speakers touched on certain specific researches in which they were engaged, and which promised valuable results in improving the properties of old materials and in giving to the metallurgist new materials as a weapon for attacking the new problems that he was having to face. For example, Dr. W. Rosenhain, of the National Physical Laboratory, spoke about the possibilities of highly purified zirconia. Bricks made of this material were being used for optical purposes, and they did not grit until well over 2,000 deg. C. Dr. J. A. Harker mentioned that zirconia, if fine enough, would stand being plunged into water at a white-heat temperature. Dr. R. S. Hutton (Sheffield) and Mr. E. Kilburn Scott told of the value of completely shrunk magnesia; the shrinking, which had to be done at a very high temperature, could now be economically effected in the electric furnace. The properties and uses, especially for electric tube furnaces, of that very useful refractory alundum, were described by Mr. C. R. Darling. Dr. W. H. Hatfield (Sheffield) pointed out how research in many directions was hampered by our not having sufficiently accurate instruments to register high temperatures. Dr. W. C. Hancock, who is working in conjunction with Prof. Bone at South Kensington on coke-oven firebricks, spoke of the application of certain organic dyes to etch refractory materials as a means of investigating their structure.

We can refer to one other portion of the discussion only, and that is the paper of Mr. Ezer Griffiths, of the National Physical Laboratory, who has devised a new and most carefully thought-out method for measuring the thermal conductivity of bricks and tiles of commercial sizes. The great difficulty was the attainment of a uniform temperature over the hot face of the irregular sample, and this was overcome by the use of a shallow bath of molten metal heated electrically. A special thermometer for exploring the temperature had also to be devised, and with these precautions extremely accurate results for a very difficult measurement have been attained. The values of the thermal conductivity and its variation with temperature as given in the paper suggested to several present the desirability of saving much waste heat in furnaces by lagging them with a highly-insulating substance, just as steam pipes are lagged. It appears that Hutton and Beard suggested this, also, strangely enough, in a paper read to the Faraday Society as far back as 1905, and yet the idea has not been adopted. It may be hoped that this interesting meeting—one visitor said, over his cup of tea at 11.30 p.m., that it was the most interesting scientific meeting he ever had attended—will be fruitful in this matter also, as it assuredly will be fruitful in many other directions in a field covering industrial products of such vital importance to the nation.

PISTON AND SMALL-END LUBRICATION IN DIESEL ENGINES.

By GEORGE B. VICKERS.

(*Abstract of paper read before the* Diesel Engine Users' Association.)

For the lubrication of Diesel engines pure mineral or hydrocarbon oils are undoubtedly the best; they contain a much smaller percentage of acid than animal or vegetable oils. The best test of lubricating oil is on the air compressor. If the oil causes pitting on the compressor valves and shows an acid scouring action on the valves in the air bottle heads, the engineer may expect the main cylinder liner wear to be excessive. Average liner wear is .010 in. to .012 in. per 1,000 hours' run, when the engine is heavily taxed. For pistons, an oil with a moderate viscosity of, say, 130 to 180 at 140 deg. F., gives good results, whilst an oil with a good viscosity of, say, 400 to 500 at 140 deg. F., is best for small end lubrication.

For enclosed-type engines thicker oil is required than with the open type, as the temperature inside the crank case is much higher than on open-type engines. In experiments on enclosed engines made by Messrs. Hick, Hargreaves & Co., Ltd., difficulty was experienced in using thin oil which had a viscosity of 110 at 140 deg. F. Thicker oil was used, having a viscosity of 140 at 140 deg. F., in place of the thin oil, and the fuel consumption, which previously had never been lower than .45 lb. per B.H.P.-hour, was reduced to .419 lb., effecting a saving of 15s. in a six-hour trial run.

On average engines the quantity of lubricating oil used is kept as low as possible by using new oil on the small ends only, and filtered oil on the other parts. This filtered oil has advantages, as after running and filtering, the bituminous matter in the oil is eliminated. Filtered oil should not be used too often on the pistons, as its viscosity gets too low for this work. The original method of lubricating the piston by a single stem leading to a belt encircling the liner, and from thence through small holes in the liner, is a poor method. The belt should be flushed out with paraffin every time that the pistons are withdrawn, or perhaps even once a week.

The usual method of piston lubrication is through four or six stems or quills leading through the water jacket to the liner, and connected by a common feed pipe, past a back-pressure valve, to the single lubricating pump. Many engineers now insist on having a separate feed to each quill, *i.e.*, they have a 6- or 8-feed lubricator fitted for each cylinder. This is undoubtedly the better plan. The pumps for piston lubrication are in the majority of cases driven from the cam shaft, and so are placed much higher than the quill line. The result is that, after a short stoppage, the feed piping has been drained, and the piston does not receive any lubrication for a few minutes after starting. A better plan is to have the lubricators fixed well below the lubricating belt line and worked off the indicator gear or the vertical shaft, thus ensuring that the pipes are always charged. The check valve in the lubricator pipe should be well designed, and periodically examined to ensure that there is no bituminous matter holding the valve up and interfering with the supply.

The method of securing the quill is sometimes the cause of trouble. Some makers prepare a tapered hole in the liner, and the quill has a rounded nose and is screwed home tight through a tapped hole in the water jacket. When the parts get warm and expand, these quills have been found to act as struts, and have caused piston seizures. An improved method is to have the quill screwed into the liner, a plain hole in the water jacket, and an external joint.

Some makers have not adopted quills in the liner, but have relied on the splash system. This system is really only suitable for small engines, and its chief drawbacks are that lubrication cannot be regulated, is most uncertain, and there is a tendency to wastage.

Phosphor-bronze bearings are usually adopted for the top

end bearings. The wear on phosphor-bronze bearings is seldom more than .001 in. per annum, whilst white metal bearings, according to the quality, may show more wear than this in one week. When a phosphor-bronze split bush is used, the average clearance is .003 in. vertically and .006 in. at each side. If the bush is solid, more clearance is required, usually .006 in. to .008 in. vertically and .008 in. at the sides. The gudgeon pins should be fully case-hardened, at the ends as well as on the bearing surface.

A good long skirt is advisable to act as a guide and to reduce the pressure per unit area due to thrust. The length of guiding surface on the piston should be 1.4 to 1.6 times its diameter for low-speed engines, but may be reduced to 1.2 times the diameter for high-speed engines. The scraper method for lubricating the top end bearings, depending on collecting the oil remaining on the liner walls after the rings have scraped the bulk off, seems a very haphazard method, but it is quite effective for pistons up to 24 in. in diameter.

In the banjo system, the oil is led into a banjo on the side of the crank, and the centrifugal force causes the oil to flow into a small receiver and pass up the pipe leading to the top end. Without a knowledge of the effectiveness of this system, any engineer would be justified in expecting that at least a special quality of oil, of the "monkey" brand, which would climb up the pipe, would be necessary for this system.

The most general method of lubrication is to have one or two slots in the piston which pass over the leads from the oil supply pipes and holes leading from the bottom of the slots through the piston to the centre hole in the gudgeon pin. Several holes lead from this central hole in the pin to the bearing surface. It is preferable to have two slots in the piston, one midway between the crankshaft centre line and the cross centre line on the front side of the piston, and one directly opposite, so that whichever side of the liner the piston is thrust against, one of the slots is able to scrape the maximum quantity of oil from the liner. The slot is best when V-shape in section, and the top and bottom should be under-cut at about 45 deg., the scraping edges being left moderately sharp; a sluice should also be cut to connect the top of the slot to the circular scraper groove cut in the piston to take advantage of the oil scraped off the walls by this groove. The hole in the centre of the pin should be at least 1¼ in. dia. for a 6-in. pin, as it acts as a reservoir for the oil. Two holes at least should be drilled from the top of the pin to the centre, one close to each end of the bearing surface at 30 deg. to vertical centre line. These holes should lead into longitudinal grooves on the top surface of the pin, with well-rounded edges to assist the oil to escape.

On medium- and high-speed engines a complete service of forced lubrication solves lubrication difficulties. Of course, this means having the engine fully enclosed. The practice of fitting a lubricating pipe leading from the bottom to the top end is to be deprecated; it is much better to have the oil passage up the centre of the connecting rod. When a priming system of lubrication is not provided, a small ball valve fitted in a cage in the hole at the bottom end of the connecting-rod acts as a retaining valve when the engine is shut down and prevents the oil from draining away from the top end.

Forced lubrication has disadvantages. Unless manufacturers have taken special precautions, it is probable that the piston will receive too much lubrication. The oil is thrown from the bottom-end bearings on to the liner walls, and when the piston is on its suction stroke, the slight pressure in the crank chamber tends to force the oil past the relaxed rings, the result being that the lubricating oil is burnt and very peaky indicators cards are obtained, showing a maximum pressure frequently 100 to 150 lb. above compression pressure. The high consumption of lubricating oil has retarded the progress of the enclosed type of engine. We have overcome the difficulties, first by guarding the bottom-end bearings to avoid splash on to the liners; secondly, by preventing the oil from creeping from the top-end bearing along the gudgeon pin keyway on to the piston surface; thirdly, by providing scraper grooves on the piston with return ducts to the inside; fourthly, by dissipating the vapour in the crank chamber, this vapour tending to get past the rings on the suction stroke.

The common method of withdrawing the oil vapour is to take the air compressor suction, or the main cylinder suction, from the chamber. This causes dirty valves, is wasteful, and has proved to be dangerous. We find that the vapour is most effectively withdrawn by a belt-driven extraction fan, and we lead the gases to a baffle box where they are condensed, thus recovering the oil which, by other methods, is burnt. The vapour is mainly caused by the oil being splashed on the inside of the piston crown, and if the crown has an oil guard fitted the vapour is considerably reduced.

A discussion followed, and Mr. W. Fennell referred to the increased sulphur contents of certain fuel oils which were now being used; it was found that these reacted on the lubricating oil, especially if this was compounded with vegetable oils, causing a sticky deposit, analogous to vulcanised bitumen, which destroyed the lubricating properties of the oil. Compounded oils should not be used for cylinder lubrication, but only pure mineral oil. He expressed the opinion that the most successful Diesel engine of the future would have a cross-head. He also strongly advocated separate lubricators for each point to be lubricated.

In his reply, Mr. Vickers agreed that sulphur would certainly have a bad effect on most compounded oils, but said that it would have no effect on a pure mineral oil.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

On Friday last, at the Institution of Civil Engineers, Lord Crewe received a deputation from the Conjoint Board of Scientific Societies with regard to the financial provision for research and allied purposes. He was accompanied by members of the Committee of the Privy Council for Scientific and Industrial Research and the Advisory Council, while the deputation numbered over 120 gentlemen, including many of the most noted representatives of the scientific and industrial worlds.

As President of the Royal Society, Sir J. J. Thomson, in an opening speech, stated that the object of the deputation was to urge the necessity of increased grants for scientific and industrial research, on the utilitarian ground that it would be an excellent investment. Such grants should not be withheld from pure scientific investigations; many discoveries most important to the world had been made in the course of researches of the most abstract character—such as the X-rays, for example, which had proved of incalculable value to the nation during the war in surgical work, but were really a by-product of research, and would never have been discovered by beginning at the other end and seeking for means to facilitate surgical operations. It was useless to grant sums of money to individuals, who would feel bound to turn out some practical result or other every year, instead of patiently pursuing an apparently unremunerative investigation without regard to appearances; the money should be allotted to the universities. The cost of pure scientific research, however, was trivial compared with that of industrial research on the full-size scale. The finances of the National Physical Laboratory were also in a very unsatisfactory condition, and it could not pay such salaries to its junior trained assistants as would enable it to retain their services.

Sir M. Fitzmaurice said that the research scheme put forward by the Advisory Council was essential to the industries of the country, and should have far-reaching effects. He had never presided over a more enthusiastic committee than the Standing Committee on Engineering; but to get the scheme into a healthy working condition money was indispensable, and that without delay.

Prof. H B. Baker, advocating the prosecution of chemical industrial research, pointed out that sulphuric acid, a fundamental necessity to industry, was still made by a process invented by a quack doctor at the end of the eighteenth century. Surely improved methods could be found, and there were numerous minor problems awaiting solution. Not only was research required with specific aims in view, but also pure scientific research. Since the war began academic and manufacturing chemists had come together, and their collaboration would lead to enormous advantages.

Replying to the deputation, Lord Crewe said that a great part of the work in question was of immediate value in connection with the war, and after the war; the fruition of the schemes for scientific and industrial research was dependent upon the attainment of a full and complete victory. The Government had decided to establish a separate Department of Scientific and Industrial Research for Great Britain and Ireland under the Lord President of the Council, with the President of the Board of Education as vice-president. They had also decided, subject to the consent of Parliament, to place a large sum of money at the disposal of the new department, to be used as a fund for the conduct of research for the benefit of the national industries on a co-operative basis. The Board of Inland Revenue had decided, with the approval of the Chancellor of the Exchequer, that no objection should be offered by their surveyors of taxes to the allowance as a "working expense" for income-tax purposes, of contributions by traders to industrial associations which might be formed for the sole purpose of scientific research for the benefit of the various trades; and the allowance would be equally applicable as regarded traders' contributions specifically ear-marked to the sole purpose of the research section of an adapted existing association. In both cases the allowance would be subject to certain conditions, *e.g.*, the association or the research section to be under Government supervision, and the trader's contribution to be an out-and-out payment, made from his trade profits, and giving him no proprietary interest in the property of the association, &c. In order to enable the Department to hold the new fund and any other money or property for research purposes, a Royal Charter had been granted to the official members of the Committee of the Privy Council for Scientific and Industrial Research under the title of the "Imperial Trust for the Encouragement of Scientific and Industrial Research." A substantial gift had already been made to the Trust by two members of the Institution of Mechanical Engineers for the conduct of a research in mechanical engineering to be approved by the Department, in the hope that this example would be followed by other members of the Institution. The Government had been impressed by the need of further assistance to research. Systematic co-operation between the leaders of industry and the Advisory Council was necessary. As it was impossible to make a close estimate of the annual cost of the work, which might vary widely, the Chancellor of the Exchequer was prepared to devote to it a very large sum, estimated to cover the needs of the next five years, on a scale which would enable them to spend four or five times as much on industrial research alone as the whole scheme had pre-

viously received. It was of no use to deal with individual firms or persons; he hoped to see the creation of new trade associations on a large scale, or the formation of branches of existing associations to deal with these purposes, with separate accounts. These associations should be controlled by small committees composed of representatives not only of industry and science, but also of the skilled workers. With regard to technical training, the present regulations under which technical schools received public money were not up-to-date; local authorities and governors of schools would be consulted, and more help would be given from the national funds. Substantial additions would be made to the annual grants to train technical teachers and provide scholarships to universities. Besides the lump sum above-mentioned, an annual vote would be provided to cover the expenses of the Department, to assist researchers and societies that were carrying out researches, and non-remunerative research. The country owed a great debt to the National Physical Laboratory and its director, Dr. Glazebrook, and its future would be the subject of anxious consideration on the part of the Advisory Council. The Coal Conservation Committee was working in close touch with the Advisory Council, and a series of researches was to be put in hand, to establish on a scientific basis systematic economy in the use of fuel. A chemical survey would be made of all the coal measures of the United Kingdom, and the qualities of the different kinds of coal would be investigated.

Notice has been given in the *London Gazette* of the creation by Royal Charter of the Official Members for the time being of the Committee of the Privy Council for Scientific and Industrial Research a Body Corporate for the purposes of the said Committee, under the title of "The Imperial Trust for the Encouragement of Scientific and Industrial Research."

Mr. H. Frank Heath, C.B., has been appointed Permanent Secretary of the new Department, to whom all correspondence should be addressed until December 31st next, at the Offices of the Board of Education, Whitehall. On and after January 1st, 1917, all correspondence should be addressed to The Secretary, Department of Scientific and Industrial Research, Great George Street, Westminster, S.W.

THE NATIONAL PHYSICAL LABORATORY.

In an address delivered to the Birmingham and Midland Institute, on Monday last, Dr. R. T. Glazebrook, F.R.S., Director of the National Physical Laboratory, showed how the Laboratory had assisted in the progress of the past 10 or 15 years, and how by its development we should gain a powerful instrument to aid us in the future.

The object of its foundation was "to bring scientific knowledge to bear practically upon our everyday industrial and commercial life." In this process three distinct stages might be observed. We needed:—

1. The work of the man of science in his research laboratory.

2. The investigations which go on in an industrial research laboratory, developing new processes or introducing new products.

3. The works laboratory proper controlling the quality of raw materials, finished products and processes.

In the first place, we must have scientific knowledge. To be successful that knowledge must be pursued for its own sake. Each of the modern practical applications of science had its foundations in purely scientific work, and we must have the student of pure research, the genius who goes on his way discovering new truths, irrespective of consequences, laying bare more and more of nature's secrets and unravelling her mysteries. In England we had never lacked such men, our roll of great discoverers had been a glorious one. The endowment of pure science was essential; without it the attempt to apply science to industry failed.

Turning to the third need—the works laboratory proper—this was necessary, if for no other reason, to maintain the standard of output, to secure that the proper grade of material was supplied to the works, to check the instruments in use, and to test the product in its various stages of manufacture. The days were gone when successful manufacture could be carried on entirely by rule of thumb, trusting to the skill of trained workmen. New processes and new products could be investigated in the works laboratory, and these investigations and tests must go on in the works themselves under the eyes of men familiar with the process of manufacture in its every stage.

Between these two—the man of science researching in his university or college, and the works chemist toiling in his shop—there was a gap. Some means were needed to make the discoveries of science available to the manufacturer, to secure to him the advantages which came from the growth of knowledge to keep him in the forefront of his trade. This was the function of a laboratory of industrial research, and among such laboratories the National Physical Laboratory should hold a prominent place. The laboratory had another function to fulfil: it was a great standardising and testing institution. Industrial research involved a laboratory very different from the usual works laboratory, and also investigations of a different type from those employed in a purely industrial laboratory. It meant a large, elaborately equipped and heavily staffed laboratory engaged largely on work which, for many years would be unremunerative, and which for a considerable time after its foundation would obtain no results which could be applied by the manufacturer. This work clearly needed a special house; it could not be done in the laboratory of a technical institute. The main work in such a laboratory as that of a technical institute must be educational. The research laboratory was necessary if progress was to be made.

For the industrial research laboratory the plant, &c., must be so planned that it was possible to carry out the necessary operations on a scale comparable with that required in works, and, moreover, the man who carried through the investigation must be not only acquainted with the latest scientific advances in his subject, but must know what was possible in works, and must mould his solution of the problem to harmonise with these possibilities. The undertaking was often more complex than that of the pure scientist. It was one which needed a special laboratory, a special equipment. Thus, the task of an institution like the National Physical Laboratory differed from that of either a university or technical college laboratory or a works laboratory. The senior members of the staff joined avowedly with the purpose of applying science to industry; they were prepared to make it their life-work. The juniors retained their posts for some time; thus all acquired a store of experience of the highest value, with a unique knowledge of the technical aspects of industry which it was difficult to gain in another way. The Laboratory had, he trusted acquired the confidence of the technical industrial world, and problems were brought before the staff with the knowledge that they would be handled in a confidential manner by men trained to deal with them.

If they were to have a National Industrial Research Laboratory, who was to pay for it? The obvious answer was the nation, but this in some quarters at once raised a difficulty. It was claimed that the results of any successful research brought profits in the first instance to some particular class, and that class ought to pay. If a manufacturer came with a conundrum which he desired to have answered for his own private benefit, he must pay; but if a competent committee controlling an industrial research laboratory concluded that a research was of importance and likely to lead to knowledge of benefit to the whole industry with which it was concerned, Dr. Glazebrook held that the cost of such a research should be met out of national funds.

The needs of the nation at the present time were too serious, the danger of delay too pressing, and the State might well devote large sums to industrial research without minute inquiry as to whether the research was going to benefit Messrs. A.B. specially and what share, therefore, of the expense Messrs. A.B. must be asked to guarantee. In America the Bureau of Standards, in Germany the Reichsanstalt and the Material-Prüfungs-Amt worked thus for the national good, and this should be the task of our English Industrial Research Laboratory.

Dr. Glazebrook then gave an account of the N.P.L. and its work during the past 15 years, and outlined the task that lay before it in the future. He said that there must be more than one such laboratory; in many cases an industry could be best served by a laboratory near its principal centre. Large firms, again, might each prefer to have their own trade secrets, but a private laboratory on a really sufficient scale was expensive, and for the smaller firms, at least, the only way to secure the full advantage of scientific advance was by co-operation—co-operation in the laboratory, co-operation, with specialisation in production, in the works themselves.

Increased funds must be provided, and it was only through the aid of the manufacturers, and of those who from experience had profited by the work of the Laboratory, that the authorities could be induced to do all that was needed to establish the Laboratory in a secure position.

On Friday last, Lord Crewe, President of the Privy Council Committee, had announced that a large sum was to be at the disposal of the Committee during the next five years, and outlined the scheme for its expenditure. The Lord President spoke in generous terms of the work of the Laboratory in the past, and indicated a sphere of wider usefulness under less difficult conditions in the future.

In many cases, no doubt, the researches contemplated must go on in special laboratories arranged and equipped for the purpose—laboratories closely connected with the industry it was desired to help, situated at the great manufacturing centres; but there were many other researches of wide interest and great importance for which a central laboratory was the proper house, a laboratory fitted and equipped in an ample manner, with a trained and competent staff animated with a love for science, and yet with a keen appreciation of the practical side of the question discussed and a real desire to help our country by the application of science to industry.

The body controlling industrial science research must have access to a laboratory in which might be studied the many problems which did not require for their elucidation appliances of the more specialised "works" character or opportunities only to be found in particular localities; where a staff was available, able and experienced, ready to attack under the advice of men skilled in industry the technical difficulties met in applying new discoveries on a manufacturing scale or to develop ideas which promised future success.

Such a rôle the National Physical Laboratory should be prepared to play; such was the future which he trusted might be in store for it.

TELEPHONE TROUBLES.

We have just been re-reading a small booklet issued by the Telephone Department, which gives suggestions to the public as to how they can assist in facilitating the working of the telephone.

We think it will be generally admitted that the working of the system is still far from smooth, but if the suggestions contained in this little booklet were followed there can be no doubt that great improvement would result. A great many of them are summed up in the injunction to be courteous to the operator. The booklet adds: "She has a difficult, nerve-racking job, and, apart from chivalry, your consideration will improve her work."

In calling for a number, many people forget that they ought to give the name of the Exchange first and the number afterwards. Subscribers are also advised to be sparing in the use of the word "Hullo." It is certainly a little over-worked by most telephone users.

It is pointed out that the times of greatest pressure on the telephone are from 10 to 11.30, from 2 to 3.30, and from 4.30 to 5.30. If these periods are avoided a subscriber is more likely to get through quickly than if he selects the busiest time of day.

A paragraph headed "Etiquette" says that *the ringer-up should never keep the rung-up waiting.* The "Hold-the-line" nuisance is perennial and exasperating.

The booklet concludes with particulars of the facilities for dispatching telegrams by telephone, and calls public attention to the fact that if the fire brigade, police or ambulance, or salvage are required in a hurry there is no need to look up a number, but all that is necessary is to ask the exchange for "fire," "police," "ambulance," or "salvage" as the case may be.

The greatest curse in connection with the use of the telephone by the public is, however, not sufficiently dwelt upon in this booklet, and that is the habit which many firms, especially the larger ones, have of entrusting their telephone business to the smallest and cheekiest boy on the premises. To ring up some of the larger firms in London means the loss of one's temper, the loss of half-an-hour, and the loss of all respect for the telephone organisation of the firms in question.

In answer to the call, the impudent small boy aforesaid begins by saying "Hullo." The inquirer asks if Mr. John Smith is in. The small boy, instead of answering the question, says "Who are you?" and after failing to listen for the reply, presently says "What's your name?" After this information is given he says, "What's the name of your firm?" and finishes up by asking what you want.

If your language is by this time sufficiently strong to drive away the smallest boy, the next size of boy kept by the firm comes to the telephone and repeats the whole performance. After that he calls a head clerk, and without giving him any of the information already elicited, leaves the exasperated caller to explain all these particulars again to the head clerk. If by this time Mr. John Smith has not gone out to lunch, the caller may eventually get through to him; but, unless his temper is extraordinarily even, he will hardly be in a fit condition to talk about business.

It is surely time that business firms, however important they may be, should realise that business worthy of their attention may arrive over the telephone just as often as through the post. It is an extraordinary thing that managers of large establishments, who would never dream of neglecting a polite letter, should leave a telephone inquiry to be dealt with in the manner described.

Troubles enough there are, undoubtedly, in the working of the system itself, but, in our opinion, these are minor matters compared with the difficulties due to the failure of business people to give intelligent attention to their telephone arrangements.

TRADE STATISTICS OF SIAM.

The following figures, showing the imports of electrical and similar goods into the port of Bangkok during the year ended March, 1916, are taken from the recently-issued official trade statistics; the figures for the year ended March, 1915, are included for purposes of comparison, and notes of any increases or decreases are given. Imports stated to be from Singapore and Hong-Kong are for the most part the products of other countries shipped *vid* these two ports:—

Parts of lamps.—	1914-15. Ticals.	1915-16. Ticals.	Inc. or dec. Ticals.
From Singapore	9,000	7,000	– 2,000
,, Hong-Kong	7,000	6,000	– 1,000
,, United Kingdom ...	11,000	24,000	+ 13,000
,, Germany	5,000	—	– 5,000
,, United States ...	7,000	5,000	– 2,000
,, Other countries ...	7,000	5,000*	– 2,000
Total	46,000	47,000	+ 1,000

*Japan.

Lamps.—	1914-15. Ticals.	1915-16. Ticals.	Inc. or dec. Ticals.
From Singapore	49,000	13,000	– 36,000
,, Hong-Kong	104,000	39,000	– 65,000
,, United Kingdom ...	53,000	17,000	– 36,000
,, Germany	15,000	—	– 15,000
,, United States ...	10,000	16,000	+ 6,000
,, Japan	70,000	83,000	+ 13,000
,, Other countries ...	9,000	4,000	– 5,000
Total	310,000	172,000	– 138,000

Electrical goods and apparatus.—			
From United Kingdom ...	112,000	146,000	+ 34,000
,, Germany	167,000	5,000	– 162,000
,, United States ...	64,000	127,000	+ 63,000
,, Singapore	12,000	5,000	– 7,000
,, Sweden	8,000	22,000	+ 14,000
,, Italy	9,000	28,000	+ 19,000
,, Austria	11,000	—	– 11,000
,, Holland	7,000	21,000	+ 14,000
,, France	6,000	5,000	– 1,000
,, Japan	70,000	27,000	– 43,000
,, Other countries ...	7,000	25,000	+ 18,000
Total	473,000	411,000	– 62,000

Manufactures of brass.—			
From Hong-Kong	483,000	452,000	– 31,000
,, United Kingdom ...	48,000	54,000	+ 6,000
,, China	76,000	52,000	– 24,000
,, Germany	5,000	—	– 5,000
,, Japan	8,000	42,000	+ 34,000
,, Other countries ...	41,000	32,000	– 9,000
Total	661,000	632,000	– 29,000

Manufactures of copper.—			
From Hong-Kong	1,000	1,000	—
,, United Kingdom ...	36,000	7,000	– 29,000
,, Other countries ...	7,000*	5,000†	– 2,000
Total	44,000	13,000	– 31,000

*Singapore Tls. 4,000. †Italy Tls. 2,000.

Scientific instruments and apparatus.—			
From United Kingdom ...	43,000	13,000	– 30,000
,, Germany	24,000	2,000	– 22,000
,, France	26,000	10,000	– 16,000
,, Other countries ...	29,000	27,000	– 2,000
Total	122,000	52,000	– 70,000

Rail locomotives.—			
From Singapore	4,000	—	– 4,000
,, United Kingdom ...	1,000	230,000	+ 229,000
,, Germany	61,000	—	– 61,000
,, United States ...	—	12,000	+ 12,000
Total	66,000	242,000	+ 176,000

Prime movers other than road locos, marine, milling, and agricultural machinery.—			
From United Kingdom ...	27,000	68,000	+ 41,000
,, United States ...	1,000	5,000	+ 4,000
,, Germany	2,000	—	– 2,000
,, Other countries ...	3,000*	24,000†	+ 21,000
Total	33,000	97,000	+ 64,000

*Sweden Tls. 2,000. †France Tls. 21,000.

Machinery unenumerated, including detached parts, and not including textile or sewing machines.—			
From United Kingdom ...	480,000	240,000	– 240,000
,, Germany	63,000	3,000	– 60,000
,, United States ...	388,000	118,000	– 270,000
,, Other countries ...	33,000*	258,000†	+ 225,000
Total	964,000	619,000	– 345,000

*Italy Tls. 7,000. †Denmark Tls. 226,000.

Machine belting.—			
From United Kingdom ...	62,000	116,000	+ 54,000
,, Germany	13,000	2,000	– 11,000
,, Other countries ...	7,000	15,000*	+ 8,000
Total	82,000	133,000	+ 51,000

*Japan Tls. 3,000.

Iron and steel wire manufactures.—			
From United Kingdom ...	48,000	79,000	+ 31,000
,, Germany	12,000	1,000	– 11,000
,, Belgium	10,000	—	– 10,000
,, Other countries ...	8,000	65,000*	+ 57,000
Total	78,000	145,000	+ 67,000

*United States Tls. 46,000.

	1914-15. Ticals.	1915-16. Ticals.	Inc. or dec. Ticals.
Railway material.—			
From United Kingdom ...	529.000	201,000	– 328,000
,, Germany	230,000	—	– 230,000
,, Belgium	234,000	—	– 234,000
,, United States ...	288,000	70,000	– 218,000
,, Other countries ...	3,000	62,000*	+ 59,000
Total	1,284,000	333,000	– 951,000

*India Tls. 30,000.

Cars or trucks for railways or tramways.—			
From Germany	4,000	—	– 4,000
,, United Kingdom ...	233,000	357,000	+ 124,000
,, United States ...	5,000	—	– 5,000
,, Other countries ...	40,000	—	– 40,000
Total	282,000	357,000	+ 75,000
Caoutchouc manufactures, other than tires.—			
From Singapore	55,000	75,000	+ 20,000
,, United Kingdom ...	28,000	30,000	+ 2,000
,, Germany	11,000	1,000	– 10,000
,, Other countries ...	7,000	13,000	+ 6,000
Total	101,000	119,000	+ 18,000

Note: £1 = about 13 ticals.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Published expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

16,588. "Electric flashlamps or torches." W. Fenton. November 20th.

16,591. "Two-way master switches for actuating sets of contactor switches for reversing motors of planing machines, &c." J. G. Stirk. November 20th.

16,600. "Portable electric battery torchlights." E. Nuttall. November 20th.

16,609. "Speed regulating mechanism for electric motors." British Thomson-Houston Co. (General Electric Co., U.S.A.). November 20th.

16,610. "Electrical switchgear." F. Bergmann (Igranic Electric Co.). November, 20th.

16,611. "Overhead trolleys for tramways and railways." C. H. Moore, R. H. Moore. November 20th.

16,633. "Means for signalling with electric lamps." A. J. Cashmore. November 20th.

16,636. "Electric lampholders, adapters, &c." J. C. White. November 21st.

16,641. "Sparking plugs for high-compression engines." W. A. Lebeter. November 21st.

16,648. "Sparking plugs for internal-combustion engines." A. S. Fletcher and S. Smith & Sons. November 21st.

16,652. "Method of supplying power to electrically-propelled trains without continuous conductors." A. Burns. November 21st.

16,661. "Electrodes for welding." M. M. Irvine. November 21st.

16,695. "Electric signalling." H. Green. November 22nd.

16,696. "Tram rails." M. E. Morgan & W. A. Morgan. November 22nd.

16,708. "Electric device for stopping railway trains that have run past signal." W. H. Whiteside. November 22nd.

16,710. "Combined pocket and suspension electric lamp." C. R. Hall. November 22nd.

16,731. "Electric flashlights, torches, &c." J. Farren. November 22nd.

16,737. "Radio-telegraph and telephone stations." F. G. Simpson. November 22nd.

16,749. "Brakes on electric tramcars, &c." R. H. Wilkinson & W. H. Turner. November 22nd.

16,760. "Dynamo-electric machines for starting and lighting systems, &c." A. E. White (U.S. Light & Heat Corporation). November 22nd.

16,789. "Means for attaching and securing electric lamps." H. M. Ainsworth. November 23rd.

16,800 "Ohmmeter." B. P. Romain. November 23rd.

16,835. "Relays." W. H. Davis. November 24th.

16,839. "Trolley-wheel guide for tramcars." G. Askey. November 24th.

16,841. "Method of attaching circuit-connecting wires on pocket electric battery, torch, &c." F. C. Tammadge & F. R. Tammadge. November 24th.

16,849. "Apparatus for preventing inverse currents in secondary discharge of induction coils." C. E. S. Phillips. November 24th.

16,850. "Electric reflectors." A. Sutter. November 24th.

16,855. "Cooling sparking plugs of internal-combustion engines." A. F. Lamkin. November 24th.

16,861. "Apparatus for circular grinding of commutators of electrical machines." A. Norrel. November 24th.

16,862. "Connection for electric leads." P. Clerget & Soc. Clerget, Blin et Cie. November 24th.

16,867. "Dynamo-electric machines." British Westinghouse Electric and Manufacturing Co. November 24th. (U.S.A., December 8th, 1915.)

16,890. "Apparatus for indicating and measuring small electric currents." A. W. Sharman. November 24th.

16,892. "Telephone instruments." International Electric Co. & H. E. R. Roose. November 24th.

16,897. "Means for automatically rendering defective telegraph signals uniform, and for storing them up preparatory to transmission." A. Fraser and Eastern Telegraph Co. November 24th.

16,900. "Searchlight, &c., operating gear or mechanism." W. Chadburn and W. R. Chadburn. November 25th.

16,907. "Connection of electric cables to junction boxes, &c." British Insulated & Helsby Cables, Ltd., and R. W. Blades. November 25th.

16,908. "Attachment of electric lamp to holders." S. Berry, C. H. Taylor and O. Grundy. November 25th.

16,944. "Electric switch." G. Markt. November 25th.

PUBLISHED SPECIFICATIONS.

1915.

14,111. Electro-magnetic Power Transmission Gearing. H. Zoelly. October 5th. (Convention date, October 6th, 1914, Switzerland.)

14,742. Telephone Exchange and like Plugs. A. Marr. October 19th. (April 19th, 1916.)

15,448. Circuit Connections of Electron Discharge Apparatus. British Thomson-Houston Co. (General Electric Co., U.S.A.). November 2nd.

15,579. Telegraph Apparatus. W. J. Mellersh-Jackson (Western Union Telegraph Co., U.S.A.). November 4th.

15,762. Electrically-controlled Clutches. W. Langdon-Davies, A. Soames and Naamlooze Vennootschap de Nederlandsche Thermo-Telephoon Maatschappij. November 8th.

16,053. Automatic Protective Gear for Electric Systems. M. Rosebourne (formerly Rosenbaum) & F. A. Couse. November 13th.

16,056. Lightning Arresters. E. C. R. Marks (Bancken). November 13th.

16,058. Electric Supply Meters. H. O. Merriman & T. Speirs. November 13th.

16,290. Portable Electric Battery Lamps. B. Pordes. November 18th.

16,854. Dynamo-electric Machines of the Commutator Type. M. Walker. November 30th.

17,060. Connection between Electric Incandescent Lamps and Holders. S. Fildes. December 4th.

17,128. Electrically-driven Vehicles. British Thomson-Houston Co. (General Electric Co., U.S.A.). December 6th.

17,166. Electric Regulating Systems. D. F. Campbell. December 7th.

17,570. Reversible Electric Step-by-step Ratchet Mechanism. I. H Parsons & A. E. J. Ball. December 16th.

1916.

The numbers in brackets are those under which the specification will be printed and abridged, and all subsequent proceedings will be taken.

358. Electric Lighting System or Circuits. H. Wrigley. January 8th, 1916. [101,985.]

951. Electric Indicators. P. M. Lincoln. January 20th, 1916. [101,898.]

1,116. Fluid-pressure-controlled Collectors for Electricity. Vacuum Brake Co., H. J. Dover & W. P. Walker. January 24th, 1916. [101,737.]

1,628. Electrolytic Apparatus for Laundry and other Hygienic purposes. E. Reuss & V. Roberts. February 3rd. (Patent No. 101,820.)

2,242. Telephonic Receiver. A. Williams & L. D. Williams. February 15th, 1916. [101,996.]

2,328. Electric Discharge Vacuum Tubes. S. Dushman. February 20th, 1915. [100,104.]

2,552. Miners' Electric Hand Lamps. A. H. Railing & A. E. Angold. February 21st, 1916. [102,001.]

2,584. Electric Furnace. W. J. Wrighton. February 19th, 1915. [100,093.]

2,600. Electric Supply Meters. Landis & Gyr Soc. Anon. February 22nd, 1915. (Patent No. 100,109.)

2,986. Electric Cables. T. O. Callender and Callender's Cable & Construction Co. February 28th, 1916. [101,914.]

3,062. Sparking Plugs for Internal-combustion Engines. A. T. Austin. March 1st, 1916. (Patent No 101,828.)

3,084. Electrolytic Production of Sodium Perborate. Deutsche Gold and Silber-Scheideanstalt Vorm Roessler. March 10th, 1915. [100,152.]

4,752. Combined Electric Lampholders and Switches. W. Donovan. March 31st, 1916. [102,012.]

4,806. Electric Signalling Systems and Apparatus, particularly applicable to Automatic Multiplex Printing Telegraphy. A. F. Dixon. April 22nd, 1915. [100,306.]

5,750. Electrolytic Refining or Extracting Process. United States Metals Refining Co. April 20th, 1915. [100,318.]

6,260. Troughing or Trays for Electric Conductors, Conduits, Pipes, and the like. May 2nd, 1916. [102,015.]

7,275. Electric Heating Apparatus. E. Erichsen. May 22nd, 1916. [102,020.]

9,139. Switch-operating Mechanism for use with Electric Transformer Starters and the like. W. Barraclough. June 29th, 1916. (Patent No. 104,853.)

9,826. Time-limit Electric Relays. British Westinghouse Electric and Manufacturing Co. July 12th, 1915. (Patent No. 100,892.)

10,099. Multiple Control Apparatus for Electric Railways. Akt. Ges. Brown, Boveri et Cie. July 29th, 1915. [101,023.]

A Metric System Ready Reckoner.—A handy and ingenious ready reckoner for use in converting British into metric measures, and *vice versa*, has been issued by Messrs. Edward Le Bas & Co., of Dock House, Billiter Street, E.C., under the title of "The Combination" Metric Ready Reckoner. The copyright is attributed to Mr. C. T. Evennette. The tables provide for the conversion of the units of length, area, volume, and weight in common use, as well as a variety of compound units, and are conveniently arranged for rapid computation, advantage being also taken of type in three colours and two sizes to facilitate reference and prevent errors. Apart from minor discrepancies, such as that between the values given for 1 lb. and 10 lb. in kg., and the irregular use of c^2 for $cm.^2$, our main criticism, as in previous cases, is directed to the illogical treatment of significant figures. The equivalents for inches, sq. inches and cb. inches are given in some instances to 3 figures, in others to 5; for feet, from 3 to 7; for yards, from 4 to 7; for lb. to kg., and for gallons to litres, 5 to 6, but for tons to kg., 8 figures; on the other hand, in the short tables for conversion from metric to English measures, and for compound measures, six figures are generally given. As a matter of fact, *four* significant figures are quite sufficient for almost all conversions involved in commercial transactions; at least four should always be given, even if some of them are ciphers; if the fifth figure is given, it might with advantage be in smaller type, or subscript. The point may be thought of little moment; it is, however, of importance—not only as embodying correct ideas of physical measurements, but also because an array of 6 to 8 figures alarms the man in the street, who naturally associates it with the metric system, whereas in fact it has nothing to do with the latter at all. The very wide use of four-figure logarithm tables, and of the slide-rule, indicates the degree of accuracy which is necessary and sufficient, with few exceptions. In a foot-note the value of the litre is given in pints to no fewer than 10 figures! It cannot possibly be measured to more than 7, with the utmost refinements.